THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 47 JANUARY, 1932 No. 1

CULTIVATION OF BANGOS IN THE PHILIPPINES

By WALLACE ADAMS, HERACLIO R. MONTALBAN, and CLARO MARTIN

Of the Division of Fisheries, Bureau of Science, Manila

TEN PLATES AND NINE TEXT FIGURES

INTRODUCTION

The remarkable adaptability of the bañgos and its acceptable qualities for the ember and pot early attracted attention in many lands. In no other fish of the same habitat are desirable characters so favorably combined as in the bañgos. Rapid of growth, vegetarian, and absolutely noncannibalistic in habit, prolific by nature, and palatable in flesh, the bañgos as a pond and food fish is without question one of the best. The availability of the fry or the tiny young in numerous quantities during certain seasons of the year is a very important factor in its favor. The bañgos is one of the few known marine species that are adaptable to artificial cultivation in salt- and brackish-water ponds.

The date of the inception of fishponds in the Indo-Pacific region is still a matter of conjecture, but the development of bañgos culture has been very slow as can be seen even in the best practice to-day, which still retains some of the original features. The present method of bañgos cultivation is the outcome of evolution through the lapse of many centuries.

The first fishponds for marine fishes were of simple construction. Small bays or inlets indenting the shores were walled at the narrowest entrance and the inclosed space was used as a pond. In the wall was an opening provided with a gate by means of which the water could interchange and the fish carried by the

incoming tide could freely enter but were prevented from returning to the open sea. Obviously, through this method, it was exceedingly difficult to control the stocking of ponds and the outcome was always uncertain.

It is claimed that fishponds of this type have reached the greatest development in the Hawaiian Islands, where they have been in use in the cultivation of mullet and bañgos for centuries. However, nothing definite is known as to the origin of these ponds, although a number of them already past the two-century mark are still in practical use. The method of construction of most of them is to build a wall of lava rock across the narrowest part of the entrance to a bay and provide a convenient opening with a gate.

The basic idea of the Hawaiian method was made use of extensively in the fishpond construction in Java, Madura, Formosa, the Philippines, and in many other localities where the development of this fishery was undertaken and the introduction of various changes became evident. In the East Indies, tide lands and mangrove and nipa swamps were found appropriate for the building of fishponds. With the conversion of these vast areas into favorable cultural sites, it became necessary to dispense with the old, inadequate, and uncertain method of stocking the ponds, and a new and more efficient way was adopted. This consisted of collecting and transferring the desired fry into especially designed ponds.

In the Philippines bañgos culture probably started on the shores of Manila Bay around the City of Manila. There have also been fishponds around Iloilo and on Mactan Island for a considerable period.

In spite of the long time that the bañgos-pond industry has been in existence, primitive practices are still in vogue in many fishponds in the Visayas. The chance entrance of bañgos and other fishes is depended upon to stock the ponds, and generally there is but one compartment to a fishpond system. Under this crude method it is, therefore, not surprising that the Visayan fishponds contain a more heterogeneous assembly of fishes than those around Manila Bay.

Until recent years there has been little improvement in the methods employed. The bañgos fishpond industry has reached its greatest development around Manila Bay, where according to estimated figures it now represents an investment of over 45,000,000 pesos. The most successful practice is in the region about Malabon, a town a short distance north of Manila. The

largest ponds are found in Pampanga, Bulacan, and Bataan. The industry has likewise been developed in Iloilo and Capiz Provinces, and in Negros. It has been established in a minor way in La Union, Pangasinan, Zambales, Cebu, Antique, Leyte, and other provinces.

The present paper is offered as a help to those already engaged in the industry and to those about to engage in fishpond culture. It sets forth ideas worked out in actual practice and those known to be an improvement over the old methods, perhaps necessary in their time but now obsolete. Portions of a similar paper [1] have been used, but for the most part the subject matter is entirely new and based largely on more recent information.

NAMES GIVEN TO THE BAÑGOS

The English name for bañgos is "milkfish;" in the Philippines it is called by the following names: Ilocano, *awa, bañgos;* Pangasinan, *awa, betel;* Tagalog, *bañgos, bangris, laon, lumulukso;* Pampango, *bañgos;* Bicol, *bañgos;* Visayan, *awa, bañglus, bañgros, cugao;* Samal and Tao Sug, *bañgilis.* The very young, or fry, are called *bugui* in Ilocano, *kawag-kawag* and *kakawag* in Tagalog, and *awa-awa* in Visayan; in Tagalog, the fingerlings from 5 to 10 centimeters long are designated as *hatirin,* those from 10 to 12.5 centimeters in length as *garongin,* and the full-grown bañgos as *sabalo* and *lumulukso,* the latter term being given to those exhibiting a remarkable leaping ability.

CLASSIFICATION AND DESCRIPTION

The bañgos is known scientifically as *Chanos chanos* (Forskål), the sole living representative of the family Chanidæ. It is a brilliant, shiny silvery-white fish, with a pale steel-bluish back. The body is fairly elongate, moderately compressed, and covered with small, smooth scales. It has a pointed head, an arched back with a single dorsal fin, and a large tail, deeply forked. The mouth is small, terminal, oblique, and toothless. A thick gelatinous substance, very thick at the eye region, covers the snout up to the nape and the eye and its neighborhood.

FOOD

The bañgos is vegetarian and subsists mainly upon diatoms and other plankton organisms, the leaves of submerged plants, and algæ. The fry feed upon microscopic plants and animals, and upon the surface scum found along the muddy bottoms of

[1] Philip. Journ. Sci. 38 (April, 1929) 451–509.

quiet shallow bays and tidal creeks. When the natural food supply is abundant the bañgos grows very rapidly.

DISTRIBUTION

Bañgos is a fish of the open sea and occurs throughout the Philippines, often entering the fresh-water rivers and such lakes as Taal, Naujan, and Bato. It is found on all the coasts in the Indian Ocean as far south as Zanzibar, also on the coasts of Asia and Formosa, and is seen occasionally along the coasts of southern Japan. In the Pacific, the bañgos may be found about Hawaii, Samoa, and East Indies, and the Society Islands and even as far as Australia and New Zealand. It is abundant in the Gulf of California and along the coast of Mexico.

BREEDING HABITS

In the Philippines as far as can be ascertained, the bañgos spawns from March to June or July. It seems to spawn off quiet shallow sandy coasts, where the fry are found along the shore in immense numbers. The bañgos is among the most prolific of fishes. A ripe female, about 75 centimeters in length taken in Subic Bay April 10, 1927, contained a little over 3,000,000 eggs. In Batavia, Java, a bañgos 1,120 millimeters long had roe about 940 millimeters in length, containing 5,700,000 eggs.

When adult, bañgos reach a length of a meter or a meter and a half.

It is a well-established fact that bañgos do not reach sexual maturity in the fishponds no matter how large the ponds may be nor how long the fish are kept in captivity. Even in lakes, such as Taal, Naujan, and Mainit, where they grow to a large size, they have never been observed to breed. The reason for this is that in these more- or less-confined surroundings the conditions are never as favorable for reproductive purposes as in the open sea.

IMPORTANCE OF BAÑGOS AS A FOOD FISH

Of more than sixteen hundred species of fishes recorded from the Philippines, bañgos is the most important. It is by far the leading fish in Manila markets, and is the product of an industry in which a vast amount of capital has been invested. Young bañgos, only a few months old, is the bañgos ordinarily found in the markets. The adult is seldom caught and is consequently rarely seen.

Bañgos has a fairly high nutritive value. The edible portion, which is 70.56 per cent of the whole bulk of the fish, is made up

of 19.24 per cent protein, 5.57 per cent fats, 0.10 per cent carbohydrates, and 131.1 calories per 100 grams.

SUGGESTIONS TO PROSPECTIVE FISHPOND OWNERS

An ideal fishpond system should be divided into a number of compartments or made up of several connecting ponds that are operated as a unit. These subdivisions naturally vary in size and depth, since they must accommodate fish of different sizes and are used for different purposes. In the region of Malabon a system of ponds for rearing bañgos from the fingerling stage to marketable size consists of the catching pond (*kuluñgan*), nursery pond (*impitan* or *bansutan*), and rearing pond (*kaluañgan*). The young bañgos with which this system is stocked are taken from such localities as Dampalit and Navotas, where they are raised in the nursery (*pabiayan*) from the fry stage to fingerling size; that is, to approximately the size of a man's finger. The other system of ponds, which is dependent upon bañgos fry for stock, is similar to the above with the exception that the nursery contains both the pabiayan and the impitan or bansutan. Each system must necessarily have a head gate for the admission and exit of water. It is located on the side of the kuluñgan adjoining the estuary (*estero*). In addition to the head gate, it is also advisable in a good fishpond system to have a secondary gate. This is usually placed between the kuluñgan and kaluañgan. A third gate, of smaller dimensions, should be provided to connect the nursery ponds with the kuluñgan.

Before engaging in the fishpond business in a locality where the industry is not yet established one should be absolutely certain that the young bañgos can be obtained nearby, or that they can be readily brought from regions where they are abundant. Those contemplating engaging in bañgos culture should spend sufficient time in the region around Malabon and Pampanga to acquaint themselves with the methods of fishpond construction and of rearing bañgos employed by the more successful bañgos growers. Such things as the construction of dikes and gates, the proper method of handling the flow of water, the care of the fry, and the growing of food for the bañgos are better learned from observation than from printed matter.

SELECTION OF FISHPOND SITE

Large areas of swamp lands or tidal flats suitable for fishponds occur along the coasts in many localities in the Philippines. In general, six factors are of prime importance in choosing a site;

namely, the soil, the vegetation, proximity of a good tidal stream, drainage, freedom from floods, and nearness to the market.

The soil.—Clay is the most desirable soil. It is not only retentive of water but is also best for the growth of the vegetation upon which the bañgos feeds. Sandy soil is, of course, not practicable, and soft mud is unfavorable to a good growth of algæ and injurious to the fish. Neither of the two is suitable for dikes.

The vegetation.—Mangrove and nipa swamps are ideal for fishpond sites. Most of the nipa palms, mangroves, and other plants are removed before using the land for a fishpond, and only a few should be left for shade.

The proximity of a tidal stream.—Great care should be taken to see that the fishpond is sufficiently near a tidal stream to insure a plentiful supply of salt or brackish water throughout the year, especially during the dry season. Fishponds may be located in the interior where the soil is loamy; the only objection against such a location is that during the greater part of the year the water is fresh, making it possible for the voracious dalag to live in the fishponds. In general the most suitable sites are marshes and deltas.

Drainage.—There should be complete drainage in fishponds, and the inflow and outflow of water must be brought under control, so that the bottom can be dried out to get rid of the enemies of the bañgos and to permit an abundant growth of algæ.

Freedom from floods.—Land with fresh-water streams crossing it and land that is subject to flooding by fresh water during the rainy season should be avoided.

Nearness to the market.—It would be useless to have a bañgos pond without a market close by or else adequate cheap transportation to a good market.

CONSTRUCTION OF FISHPONDS

The cost of constructing a fishpond varies with the soil to be worked, whether clayey, muddy, or rocky; with the topography, whether level, sloping, or undulating; with the vegetation present, whether nipa, mangrove, etc.; and also with the labor conditions of the locality.

Dikes.—After the site has been selected, the next step is to plan the layout of the fishpond system. Once the location of the main dike about the pond has been marked off, the cutting of mangroves or nipa palms is started. Sometimes at the beginning only the portion of the main dike and the adjoining strip

of land from which the soil is taken for the dike are cleared. In the construction of the main dike, the soil is removed from the middle along its entire course to a depth of 30 to 60 centimeters and to an equal width, forming a V-shaped trough called a puddle trench (*mecha*). The soil removed is placed on the outside bank of the trough. The soil for filling the trough and main dike is taken from the inside of the pond, leaving a berm about as wide as the base of the dike. A marginal canal or borrow pit is thus formed. This is deeper than the rest of the pond (fig. 1).

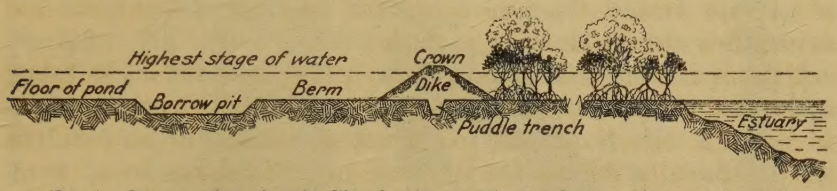


FIG. 1. Cross section of main dike showing puddle trench, berm, borrow pit, and floor of pond.

The dike is not raised at once to its required height, but this is attained by piling up mud layer by layer and allowing each layer to shrink before another is laid on. The dike should be about 30 centimeters higher than the level of the highest tide during the year. The crown of the dike should be at least 50 centimeters in width, and the slope 1.5 meters horizontally to 1 meter vertically. The puddle trench referred to above serves to make the dike more resistant to water pressure, prevents seepage of water, and closes holes bored by crabs, sea mantes, and sea scorpions. All stumps, logs, and sticks of wood should be removed, for if left they will rot and ultimately let water escape. Dikes should be made strong enough to render them capable of withstanding inundations and freshets. Sometimes rows of mangrove (*bakawan*), *Sonneratia* (*palapat*), and nipa palms are planted in front of the dikes, especially if they are along the river bank. The purpose is to hold the soil and break the violence of the water current, wave action, and wind.

Gates.—Gateways are, of course, necessary in the dike to control the inflow and outflow of water (figs. 2 and 3). There should be one head gate to every 10 to 15 hectares of fishpond. It is placed in that portion of the pond where the entrance and outflow of water would be most effective, usually near the mouth of a creek or at the deepest portion of the pond to allow complete drainage.

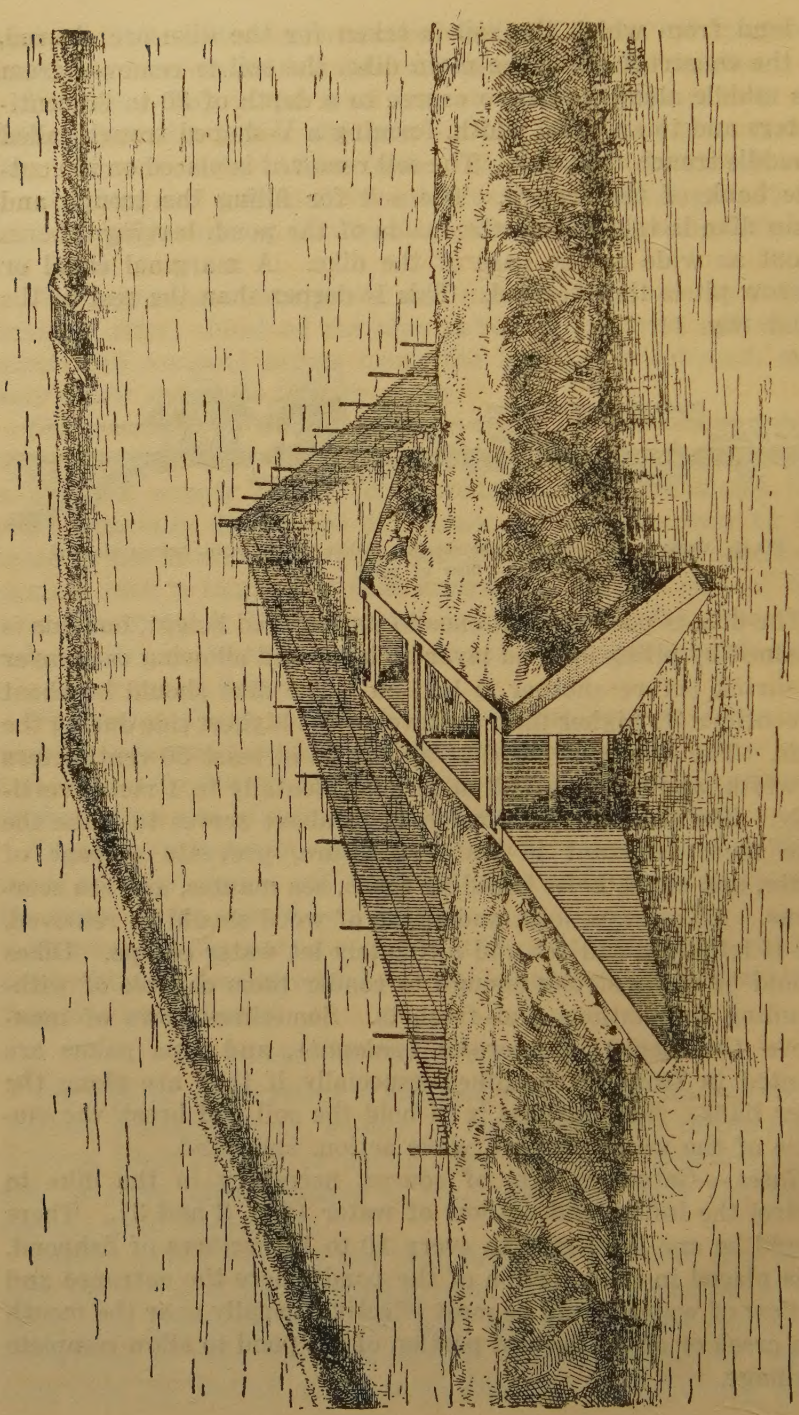


FIG. 2. Schematic sketch showing kuluñgan, head gate, saplad, and secondary gate in background.

The main gate should be constructed of concrete. Formerly this was made of stone and cement, brick, or even of wood, but the superior merit of concrete for construction is gradually forcing out all other materials. The main gate should be of ample dimensions, with a large base set on a very strong ground foundation. If the ground is soft and lacks uniformity it is necessary to drive bamboo or hardwood pilings. The width for the passage of water in the gate should be about 1 meter (fig. 3).

A rectangular space is dug in the ground where the gate is to be constructed. If the site selected is submerged most of the time an inclosure of mud is first made before digging is started. The space is kept as free as possible from excessive water while excavation and work on the floor and basal portion of the gate are in progress by bailing the water out. After the required depth is reached bamboo or hardwood piles a meter or more in length are driven into the bottom. The heads of the piles are covered with concrete mixture about 20 centimeters in thickness, in which $\frac{3}{8}$-inch reënforcing bars are placed for additional strength. This concrete layer or base forms the floor of the gate and should be lower than the bed of the pond. The side walls and wings of approximately the same thickness as the floor, properly reënforced, are erected over the concrete base. They should be as high as the dike. The wings should extend out diagonally to the extreme base of the dike from the ends of the side walls, to prevent the water cutting in at the sides. As protection against the undercutting effect of the water, the gate should be provided with an apron at each end, which should extend as far as the wing walls. The apron should slope down considerably so that its extreme lip will be at the lowest level of the water at the point of entrance. For all concrete mixtures for the construction of gates, the proportion should be 1 part of cement, 1.5 parts of sand, and 3 parts of gravel.

Three pairs of vertical grooves are left in the side walls. The middle pair is fitted with guide boards along which the slabs or boards of durable wood, placed edge to edge, slide up and down. These slabs may be removed or inserted to regulate the flow of water or stop it altogether. The two other pairs of grooves are at the entrance and the exit of the gate. They are both for the sliding screens made of closely wooven split bamboo or metal screening. These screens allow water to pass through freely but more or less successfully prevent the entrance of undesirable fishes, crabs, water snakes, and other aquatic enemies, and prevent the escape of the bañgos. The opening of the gate

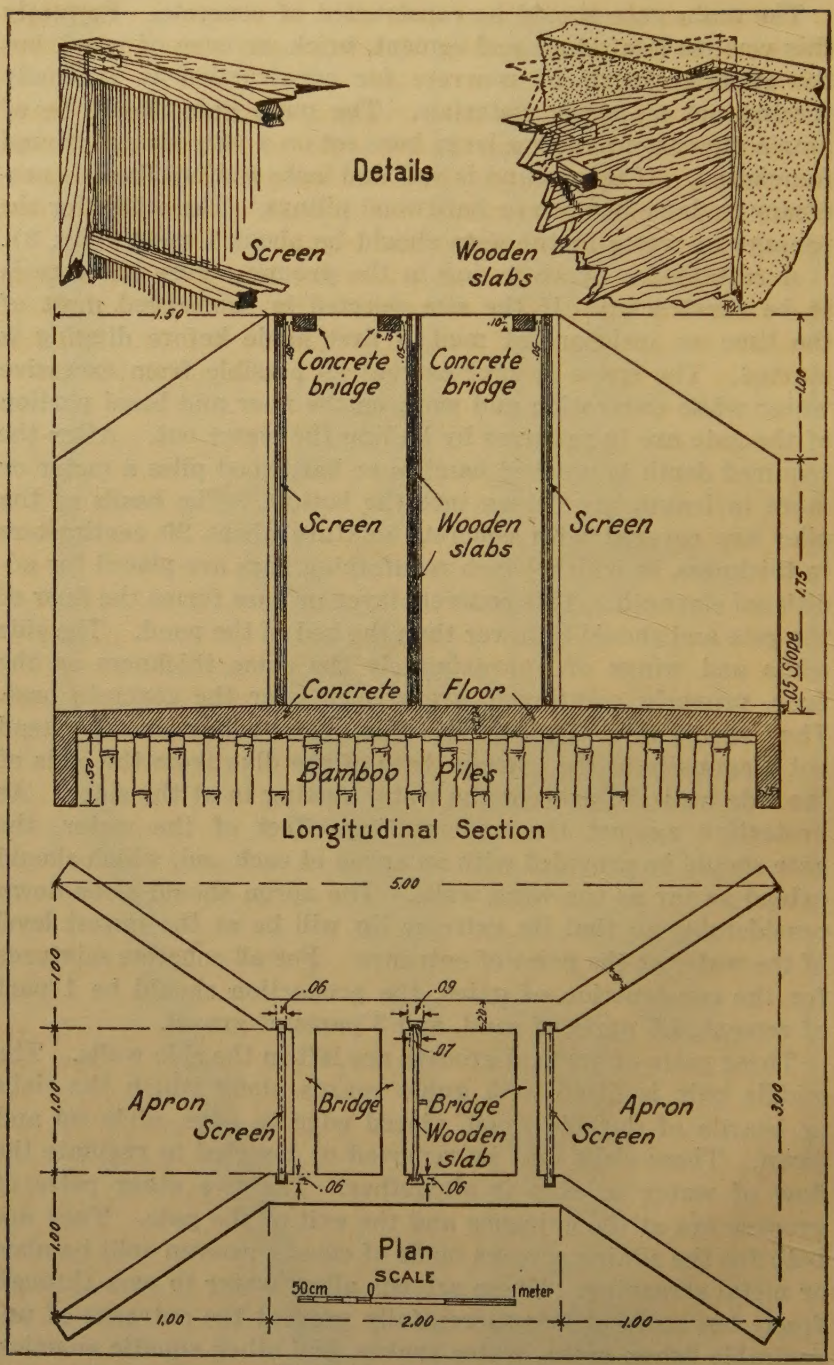


FIG. 3. Details of head gate.

is bridged at the top behind each pair of grooves to facilitate the work in setting or pulling of screens and slabs and to give additional strength to the structure.

In addition to the main gate or gates, it is necessary to have gates of smaller dimensions to allow water to pass to the different compartments; such as, the large rearing pond and the nursery. These gates, like the principal one, should be of concrete, and should have the sliding screens and boards.

Subdivisions.—A system of ponds for rearing bañgos from the fingerling stage to a marketable size includes kuluñgan, impitan or bansutan, and kaluañgan (figs. 4 and 5). The kuluñgan is a small subdivision, usually 15 to 20 meters in diam-

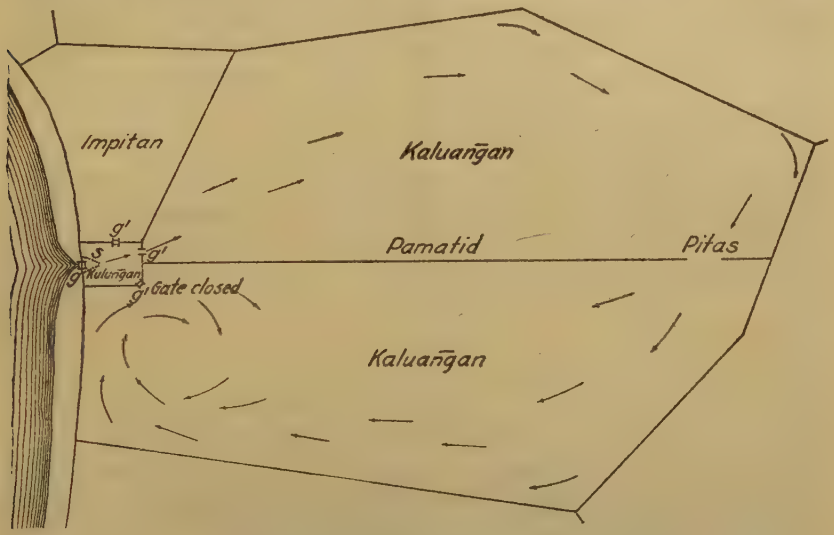


FIG. 4. Fish-farm layout; showing the effectiveness of pamatid in creating circulation of water in the kaluañgan; *g*, main gate; *g'*, gate of wood or concrete smaller than *g*; *s*, saplad.

eter, into which the water from the outside flows directly through the main gate (figs. 4 and 5, *g*). It is provided with smaller gates (figs. 4 and 5, *g'*). *S* in the same figures is the *saplad,* fashioned after a simple fish corral having two diverging walls like the letter V with the apex closed. Sometimes it is arranged in the form of a semicircle. It is used to prevent fish from swimming out of the kuluñgan when the gate is left open or in case the screens break. Properly speaking, the kuluñgan is the catching pond, but literally the word itself means "an inclosure."

The impitan has a triple purpose. Sometimes when only bañgos fry are available, they are placed in the impitan making

it serve as a fry pond, or pabiayan. It is used as a *palakihan* where the *hatirin* are allowed to grow to *garoñgin* size at which stage they are ready to be let loose in the kaluañgan. In case of an untimely shortage of lumut and where it is desired to produce two crops a year this subdivision serves as impitan proper, and also as bansutan, or retaining pond, where the fish are kept until a new supply of lumut grows in the kaluañgan and until the rearing pond is ready for the second crop.

The largest subdivision is the kaluañgan, or main rearing pond, where the fish coming from the nursery system are allowed to grow to marketable size.

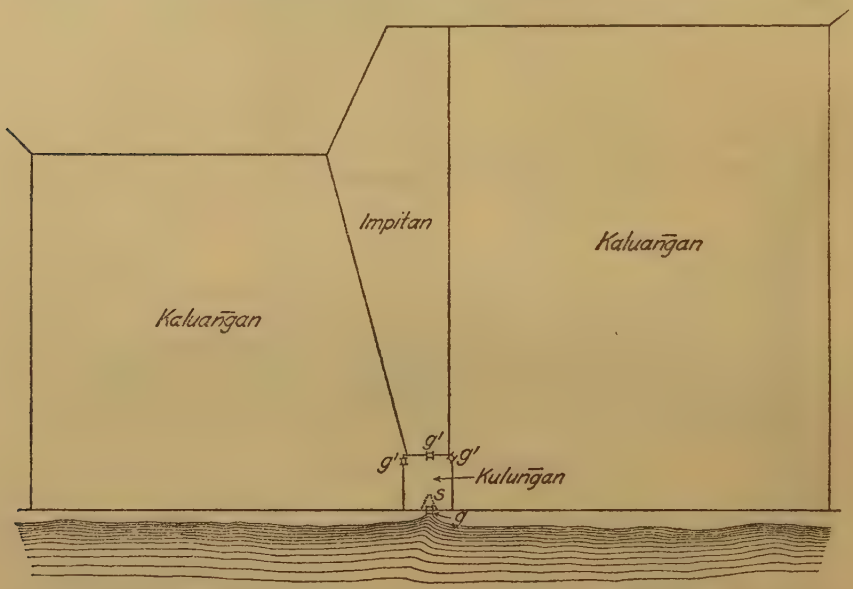


FIG. 5. Another type of fish-farm layout; *g*, main gate; *s*, saplad; *g'*, gate of wood or concrete smaller than *g*.

Canals.—Canals are as indispensable as the kuluñgan but should not be deeper than the latter. Drainage of the kaluañgan and impitan is made possible by sloping the bed of the canals at a sufficient grade to permit the water to empty through the gates into the kuluñgan. The canals are usually located across the greatest diameter of the pond and are deep enough to serve as resting places for the fish in the evenings and during hot days. If well dug and properly located they make good collectors during the catching season.

Pamatid.—The pamatid (from *patid,* meaning "to cut" or "short cut") is the dike that divides the kaluañgan into two

ponds. It serves a triple purpose. If the pond is large the pamatid serves as a shorter pathway to the farther end and either of the two subdivisions may serve for growing lumut in case the supply in the other is consumed. For this use the pamatid is provided with temporary gates, or *pitas*, which are closed after the fish have been transferred from one division to another. When the pitas is left open it allows the water to circulate and this freshens the pond water very effectively. It also serves to keep the lumut from being driven from place to place by the wind.

THE BAÑGOS FRY

Source of the bañgos fry.—Very little is known of the breeding habits of bañgos. It is supposed that they come to shallow sandy coasts to lay their eggs, which are of the floating type.

The very tiny, transparent, big-eyed bañgos fry, measuring 12 to 15 millimeters in length, swim in vast shoals near the shore line of shallow sandy coasts and enter estuaries and tidal creeks. They come in with the advancing flood tide and go out with the ebb, and, therefore, are always surrounded by fresh, cool, but shallow water. A knowledge of this fact is fundamental to the successful culture of bañgos.

In their natural habitat, it is not easy to distinguish these tiny bañgos from their common associates, such as, the fry of mullet (*banak*), tarpon (*buan buan*), and cutlass fish (*liwit*), which they closely resemble. A casual observer may find it almost impossible to differentiate one from the other. However, those who have acquired or developed through experience sufficient powers of discrimination are able to identify these creatures with a high degree of accuracy.

The capture of bañgos fry is a very important industry. The flat sandy coasts of Balayan and Batangas Bays, Batangas Province, furnish by far the largest quantity, and the annual license fees for catching the fry in this province amount to nearly 50,000 pesos. The fry captured are shipped to Malabon and other points around Manila Bay. Large quantities are also caught and shipped to Manila Bay growers from Mindoro, Marinduque, Tayabas, Sibuyan, Samar, Leyte, Tablas, Zambales, Pangasinan, La Union, and Ilocos Sur. Fishponds in the Visayan Islands are supplied with bañgos fry coming from Santa Rosa, near Mactan Island, and other points in Cebu Province, from Tanjay in Oriental Negros, from the southern portion of Iloilo Province, and from the coast of Antique, while the excess

catches are sent to Manila for distribution to bañgos-fry dealers and growers. Most of the shipments are made in native sailing boats, but a good many are sent by truck to some railroad point or steamer.

Methods of catching.—Two methods are employed in catching the fry. Along the shore, the *sayod*, or *sagap*, is used. This is a seinelike device made of coarse sinamay, measuring about 1.5 meters wide by 5 meters long. It is used in the same manner as any seine. Only two persons, one at each end, are needed to operate it. Two men keep dragging the seine until a large number of fry are caught.

The other method is by means of the saplad employed along the mouths of estuaries and tidal creeks. The saplad consists of two parts, the wings and the saplad proper which is a hammock-like net mounted on two bamboo frames. The two wings are set firmly in the ground in a V-shaped form, with the opening facing the sea. The point of intersection is left open for the fry to pass through into the saplad during the incoming tide. The wings are usually made of crushed bamboo (*tinidtid*) tied in place to a number of bamboo poles or stakes. This apparatus is set in shallow places where the water is up to about a meter in depth. It may be used to cover the entire width or only a portion of an estuary or tidal creek.

Sorting.—The fry are dipped from the sagap or the saplad by means of a basin, and before they are poured into earthenware jars the dirt is removed by means of a small bamboo brush (*cahig*) and the fry of other kinds of fishes are taken out. When the fry are few, sorting is done by picking out the undesirables by hand from the basin, but when there are so many that sorting by hand is impracticable, a sieve (*sala-an*) is used. It is an open-top rectangular box, two sides of which are made of wire netting, with the mesh of sufficient size to allow only bañgos fry to pass through. When in use, the sieve is placed on the sagap, which is kept partly immersed in water. The fry are then poured from the basin into the sieve. Those that pass through the sieve are held in the sagap, from which they are dipped up and placed in the jars.

Counting.—Counting the bañgos fry one by one is very tedious work, especially when there are many thousands of them. To facilitate this procedure the so-called *palyok* system is used. Persons engaged in the business always have at hand one thousand, or any counted number, of small pebbles or cowries (*sigay*). One man attends to the fry and another has the counters.

A clam shell or small bowl is used for dipping out the fry from one basin into another. After each dip the man calls out the number of fry in the dipper and the other man separates a corresponding number in counters from the counted heap of pebbles and sets them aside. The same process is repeated until the counted heap, say one thousand, is used up. Once counted, the density of the thousand fry as they appear in the basin is taken as a basis for the counting of succeeding thousands; thus, a basin of fry of approximately the same density as the first-counted batch will represent one thousand.

After the sorting and counting in the fishing ground, the fry are placed, as soon as possible, in low, wide-mouthed, pot-bellied, unglazed earthenware jars, palyok, which range from 15 to 30 liters in capacity. The jars are then covered, usually with leaf sheaths of the areca, or betel, palm.

Originally the water in the jars is sea water. However, it is gradually diluted with, or sometimes entirely changed to, fresh water as the jars stand in transit or waiting for buyers. Naturally, the fry coming from far-away places are weakened by their long journey in confined quarters. At Manila the fry are usually purchased by men from Malabon who make a business of handling and rearing them and supplying the fishponds. Some of the owners of the large fishponds receive their supply of fry directly from the fishing grounds.

On arrival at the market, as at Tutuban, the jars are carefully examined, and all dead fry removed. Usually from 5 to 10 per cent in each jar die in transit, and in the jars that are shipped long distances the mortality reaches 25 per cent. It is claimed that bañgos fry can stand, at most, fifteen days without feeding in jars half full of water. After the dealer has sorted the fry, the purchaser counts them. The counting is performed in the same manner as before. They are bought and sold by the ten thousand, or *lacsa*, and the price varies according to the season and place.

THE FRY-POND SYSTEM

The layout, construction, and operation.—The fry purchased by men from Malabon who make a business of handling and rearing them and of supplying fishponds in the provinces are taken to a place like Dampalit, where numerous nurseries or fry ponds are located. The fry ponds are so constructed that complete drainage of the water is possible. There is a gradation in the level of the floors of the different parts in the same

manner as in the large rearing ponds, or kaluañgan. A complete fry-pond system (fig. 6) in Dampalit consists of the pabiayan, where the bañgos fry are first placed and reared; the catching pond, or kuluñgan; and the canal, or *sangka*. The general characteristics of this system are small compartments, shallowness, low-partition dikes with small gates, and pipes, or *pansol*, for drainage and intake. The pipes are usually made of trunks of *Livistona* (*anahaw*). The pabiayan is the principal part of the system. Its floor should not be level, for in that case drainage would be difficult. In order to provide efficient drainage, a canal is usually made diagonally or sometimes lengthwise

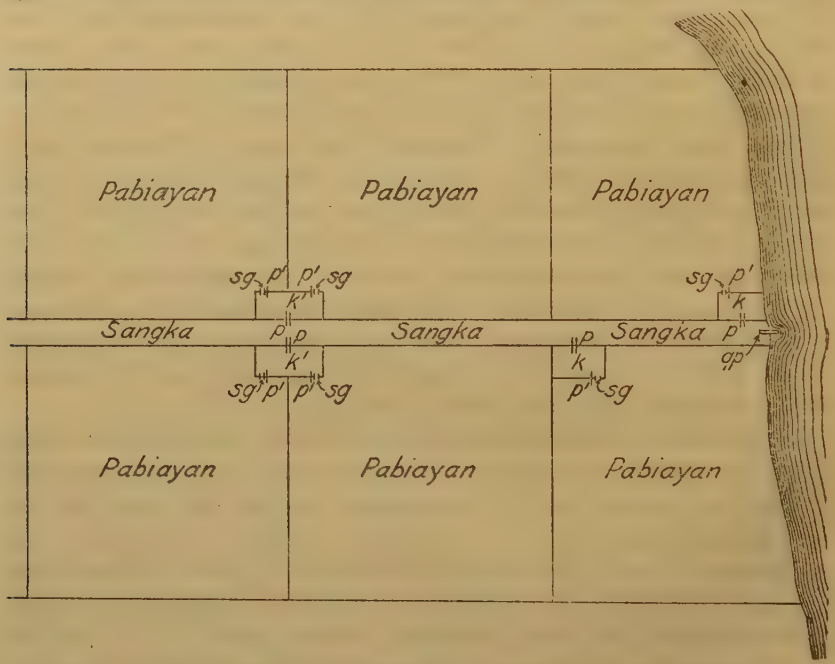


FIG. 6. Fry-pond system; *k-k'*, kuluñgan; *p-p'*, pansol; *qp*, quadrangular pipe; *sg*, small wooden gate.

across the pabiayan, and the bottom of the pond is so well graded that the water when released flows from all parts into the canal. The bed of the canal also slopes gradually, its deepest portion being at the end where it communicates with the gate of the kuluñgan as shown in fig. 6, *sg*. Besides facilitating drainage, the canal serves to collect young bañgos and lead them into the kuluñgan during the catching season, and also serves as a retreat for the fish during very warm periods. The partition dikes separating the compartments are usually about 60 centimeters in height.

The kuluñgan, *k* or *k'*, in the fry-pond system is used in the same manner as that of the ponds for larger bañgos. It is customary to locate it at one corner of the pabiayan—at either one of the corners adjacent to the sangka. If the pond is an irregular polygon, the corner chosen for the kuluñgan is the one from which the canal runs the longest diagonally. It is very necessary, however, that each pabiayan should have one kuluñgan. The general practice is to construct one or two adjacent regular polygonal ponds as shown in fig. 6, *k'*. This is done for economy of labor and mud. The same reason holds true in constructing kuluñgan at each corner as shown in *k*. In that case only two sides have to be constructed to make the subdivision. The kuluñgan should be deeper than the canal of the pabiayan.

Water is admitted into the kuluñgan by means of a pipe at *p*. Sometimes two pipes are employed, one set lower than the other and usually placed close to the floor. Both serve as drain and supply pipes. The lower pipe is called *pansimot* and is used to drain off the water completely at times when it is wanted to dry the pabiayan. A small gate, *sg*, usually of wood, is located at one corner of the kuluñgan. Another pipe, *p'*, is placed near this gate to serve as drain and supply tube for the pabiayan when the gate is temporarily closed with mud.

The sangka is a large canal about 1.5 meters at most in width. It is the deepest part of the fry-pond system, but should not be deeper than the river from which it gets the supply of water. Complete drainage is effected by having its bed slope gradually to one end, at which is constructed a gate or a large quadrangular pipe, *qp*, also called pansol. If this type of pansol is used, it is provided with a sliding board for regulating the flow of water and with screens at both ends to prevent the entrance of undesirable fishes. The sangka is used by some fry growers as kuluñgan for young bañgos of garoñgin size.

In operation, the water from the river flows into the sangka through the gate or pipe at *qp*. From the sangka it goes to the kuluñgan through one of the pipes at *p*, then to the pabiayan through the pipe at *p'*. In draining the pond, the water is let out through the same openings in the reversed order.

Food.—The proper and best food for the fry under cultivation is *lab-lab*. Lab-lab is the Tagalog name for the plant complex that under certain conditions forms a crust or mat upon the floor of the nursery pond. It is largely composed of unicellular, colonial, and filamentous blue-green algæ; it also contains a great variety of diatoms, bacteria, some unicellular green algæ,

a small proportion of very fine threads of filamentous green algæ, Protozoa, minute worms, and small crustaceans.

Before stocking the pabiayan with bañgos fry, the lab-lab is grown in order that a ready supply may be provided for the fish. Preparatory to its growing, the pond bottom is washed two or three times by allowing water to flow in and out freely. Water is admitted at high tide and then let out with the ebb. The pond is then exposed to the sunshine to dry for two or three days. This practice has two purposes; namely, to kill the enemies of the bañgos fry and to promote the growth of the lab-lab. When the bottom is sufficiently dry, water is turned in to a depth sufficient to cover the bottom, usually from 3 to 5 centimeters. In admitting water into the pond, care is taken that the pipe is covered with a *galao,* which is wrapped in fine-meshed sinamay cloth to serve as a screen. The object is to keep the other kinds of fishes from getting into the pabiayan before it is stocked with fry. The galao is an elongate, fine-

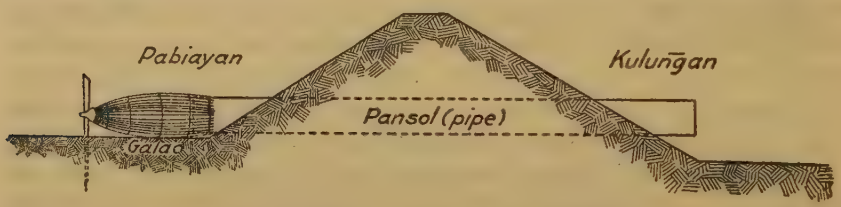


FIG. 7. Cross section of dike separating pabiayan from kulungan showing the position of pansol and galao.

meshed, woven-bamboo basket, shaped like certain types of fish trap, or *bobo* (fig. 7). Its size depends upon the size of the pansol. After three or four days a growth of lab-lab should appear on the bottom of the pond. The pond is not allowed to dry, and the water is maintained at a depth of 3 to 5 centimeters until the growth of lab-lab forms a dense, thick mat over the entire floor. Then the water is gradually increased to approximately 12 centimeters, but is not allowed to get deeper than this for filamentous algæ (*lumut, jusi*), which cannot be used by the tiny fry, will start to develop.

CARE OF THE YOUNG BAÑGOS IN THE NURSERY PONDS

Stocking of the ponds commences in May when the fry are available from the spawning grounds or the market. The pabiayan should be ready for occupancy when the jars of fry are delivered. To place the fry in the nursery, a jar is set in the water, tilted to one side, and the pond water allowed to

flow gently into it. The jar is then slowly and carefully turned over until the fry swim out.

Effect of temperature.—The temperature of the water in the pond is a matter of great importance. It must be cool and should be as nearly as possible of the same temperature as the water in the jars. As the jars are made of unglazed earthenware the constant evaporation of water through their pores keeps the water cool inside. Late afternoon or early morning is the best time for transferring fry from the jars into the pond.

Effect of weather conditions.—The first three or four days that the fry are in the nursery constitute the most critical period. If heavy rains fall during that time, the sudden change of temperature and salinity of the water causes a great mortality. The sediment carried down from the dikes by rain water may kill the fry by suffocation. On account of their weakened condition from their long journey in the jars, the fry are very susceptible to these conditions. It is, therefore, necessary to make careful observations of the weather and if rain threatens, the planting of the fry in the pabiayan should be delayed.

Care in preparing the pond for stocking.—The fry should be planted before the lab-lab starts to float, as they will die if they become entangled in it. Care should also be taken not to hurt the fry in planting. Before transferring the fry into the pabiayan, one should be sure that the pond is well washed with clean water to rid it of the old water that is highly saline as a result of constant evaporation. It is advisable to introduce new salt water from the river into the pond before the fry are planted.

The fry pond should be carefully watched to prevent the entrance of enemies, such as water snakes and carnivorous fishes. To a large extent the galao wrapped in sinamay cloth excludes most of them and at the same time prevents the tiny fry from escaping. At this time the small gate is temporarily closed with mud, but when the young bangos have reached the fingerling stage this gate is used and the flow of water is controlled by means of the sliding boards. Water in the pond should be replaced now and then to prevent it from growing stale. When the fry are seen staying near the surface, it is a sure sign that the water is bad and needs changing. Sometimes the water in the river gets bad, and in this case auxiliary ponds to be used as reservoirs for fresh water are useful.

Some birds, like the herons and kingfishers, are very serious enemies of the bangos fry. It is often necessary to post a watchman armed with a shotgun to kill or scare off such birds, especially around the newly established fishponds.

Number of fry required for stocking.—The number of fry to be raised in a pabiayan depends upon the growth of lab-lab. The number should be adjusted to the quantity of food available for the maintenance of the fish for a certain length of time. It has been estimated that a hectare of pabiayan with a good growth of lab-lab should not have more than 500,000 bangos fry.

Catching, counting, and delivery of hatirin.—Hatirin are young bangos of the fingerling size; that is, about 5 to 10 centimeters in length. The fry reach this size in about two to three months. The nursery ponds in the provinces are generally stocked with these from May to August. There is no definite time for catching the hatirin. Demand regulates when they are caught and delivered. They are collected in the kulungan and kept there for one day without food before delivery. This explains why lumut is not allowed to grow in the kulungan. The fish are then caught with a large fine-meshed seine (*panagap*), 6 to 8 meters long and 3 or 4 meters wide, which is employed to surround them. The hatirin are now scooped up from the panagap by means of cans and transferred into a large dip net (*bitinan*), which is kept partly immersed in water near the bank of the river so that the fish are always under water. The bitinan is supported at each corner by a bamboo pole driven vertically into the ground.

In counting, the fish are driven towards one end of the bitinan, and divided into two approximately equal portions by watching the density of the fish. One portion is let loose, and the other is divided into two equal parts. This process is continued until the number left can be counted easily. The last portion is then counted by means of the palyok system referred to previously and if it represents one-eighth of the total, the counted number is multiplied by eight to obtain the number of hatirin originally placed in the bitinan.

When the hatirin have to be transported long distances a large clean banca (*pamandawan*) is used. The boat is partly filled with clean salt water, and the fish are placed in it. Two screened holes in the banca provide circulation of water, and men bail constantly to keep the boat from sinking. If the distance is very great the banca is towed by a motor boat. Trans-

fer of the hatirin is usually done during the cooler part of the day.

At the place of destination the newly delivered fish are retained first in the impitan. This is a subdivision that can still be considered the nursery. Its size is governed by the size of the rearing pond, or kaluañgan, and it is used in fishpond systems that are dependent on nursery ponds, or pabiayan, in Dampalit and Navotas for their supply of young bañgos, or hatirin. A hectare of first-class impitan will carry about 15,000 to 18,000 hatirin until the large pond is ready.

Before the hatirin are ordered for planting in the impitan, it should be drained and left dry for from three to seven days, depending upon the weather. All snakes, mud skippers, and other enemies should be destroyed. Then the water should be turned in gradually to a depth of about 10 centimeters, which will start lumut growing all over the bottom of the pond, in small bunchy patches. As the lumut grows, the depth of the water is gradually increased. The little hatirin nibble away at the young lumut, and if the proportion is correct there will be sufficient feed for a time. In the meanwhile the large pond, or kaluañgan, should be prepared in the same way with a fine growth of lumut, for the hatirin are only kept in the impitan until the larger pond is ready for them.

In some places where the soil conditions are not favorable, it may be necessary to grow lumut by transplanting. First the pond is drained and well cleaned as previously described. Then water is turned in again to a depth of 10 centimeters, and clumps of lumut are planted. As soon as the new growth begins, the depth of water in the pond is steadily increased until the normal depth is reached. By that time there should be a sufficient growth of lumut so that fish may be turned into the pond.

The hatirin are usually kept two or three months in the impitan, to which they were transferred from the pabiayan. At the end of this period, they are 10 to 12.5 centimeters long and are called "garoñgin." The garoñgin are ready for planting in the large rearing pond if the growth of lumut is abundant. In case of an insufficient supply, the fish are simply retained longer in the impitan until the rearing pond is ready. A portion of the supply of garoñgin may be held in the impitan for a longer period as stock for the second crop, if it is desired to produce two crops in a year.

There is no fixed time for putting the garoñgin in the kaluañgan. Whenever one has a pond in proper condition and can get strong healthy garoñgin, then is the time to plant.

CARE OF THE GROWING BAÑGOS IN THE KALUAÑGAN

Stocking the kaluañgan.—The number of fish per hectare in ponds stocked for the market depends upon the condition of the pond. A pond in good condition with a luxuriant growth of lumut can carry from 1,000 to 1,500 hatirin or garoñgin per hectare till ready for the market.

Among beginners the commonest mistake is to overstock the pond. Overstocking results in heavy losses or even failure. The more fish in the pond the higher the percentage of deaths. The supply of lumut is soon exhausted, and the undernourished fish crowd one another so that they do not have room to exercise and develop properly. This results in the disposal of the bañgos long before they are large enough to bring a profitable price, or delays the harvest because the fish have to be transferred back to the bansutan until lumut can be grown in the kaluañgan. Sometimes a fishpond owner attempts to supply the lack of lumut in his pond by collecting lumut in the rivers or by buying it from other fishpond owners, but this practice cannot be relied upon.

Food of the bañgos.—The diet of bañgos under normal fishpond conditions is almost exclusively composed of filamentous green algæ, or lumut. As previously explained, the fry first feed upon lab-lab but gradually change their habits until they feed only on lumut. Where conditions are favorable the algæ grow in dense masses over large areas, frequently almost completely filling the pond.

Various hydrophytic flowering plants also occur in bañgos ponds, and the general name *digman* is applied to all of them. They thrive best in the rainy season when the salinity of the water in the ponds is reduced. Certain kinds of digman occur only in salt-water ponds, sometimes entirely covering the bottom, rooting in and creeping over the mud and remaining entirely submerged. When the salinity of a pond is very greatly reduced, duckweed, or *lia*, may appear and increase till it nearly covers the surface of the pond. The presence of lia under such conditions is an indication that the pond is not in good condition.

When bañgos are sick, instead of swimming in groups or small schools as is their habit, they usually scatter. They become sluggish and inactive in contrast to the healthy bañgos,

which are noticeable for their swift movements. When the pond cannot supply enough food, some people soak rice bran, or tikitiki, overnight till it sticks together, then place it on the bottom of the pond in small mounds for the bañgos to eat. Bañgos have been seen feeding upon grass projecting from the dikes into the water.

Freshening of pond water.—The freshening of the water in the ponds is as essential for the proper development of the bañgos as the care given to the repair of the dikes, the growing of algæ, the killing of enemies, etc. The pond water stales after a certain length of time and since it cannot be changed completely, once the pond is stocked with fish, it is merely freshened. In ponds with a single head gate, freshening is carried on by admitting water during high tide. The sluice is kept open until the tide starts to recede. The next day a portion of the pond water is let out through the same gate during ebb tide and new salt water from the river is allowed to flow in when the tide rises, as before. In large ponds having several gates, water should not be allowed to flow in and out through the same gates, as in this case the recently admitted water is thrown out. Gates on one side should be employed as supply gates and those opposite for outflow. In this way the freshening of the water can be handled more effectively and efficiently. Usually the ponds are freshened twice a month, during full and new moon when tides are high.

In freshening the water, care should be taken that the pond is drained slowly so as to give the fish time to go to the canals, thus preventing them from being stranded on the exposed portions in the pond. There should be a corral, or saplad, inside a kulungan behind the head gate as a precaution against fish escaping through the opening or jumping over the gate and dike. All the parts of the gate, however, should be properly set in admitting or letting out water.

The caretaker should see that all leaks in the ponds are stopped, and should always be on the lookout for holes bored by crabs, sea mantes, and sea scorpions.

Nipa palms in the pond.—In some places a few nipa palms are left growing in the pond to provide shade for the fish and to prevent the wind from blowing all the algal growth to one side.

RATE OF GROWTH OF THE BAÑGOS

The weight a bañgos should attain within a given length of time is unknown, as there are many factors that determine

the rate of growth. Some of the more important of these are the following:

1. The rate of renewal of the pond water, or the time elapsing between freshening the stale water with clear tidal water of the proper salinity.
2. The circulation of water within the pond system.
3. The amount of rainfall.
4. The sudden variations in salinity.
5. The character of the bottom soil of the pond.
6. The kind, the quality, and the quantity of food available per fish.
7. The size and depth of the stock ponds.
8. The number of fish to the hectare.
9. The number of other fishes living upon the same kind of food as that eaten by bañgos.

Hatirin let loose in the kaluañgan grow in size more rapidly than in the nursery ponds. This is due principally to the abundant growth of algæ, to the large pond, and to the great volume of water. It has been observed that the growth of the bañgos is slow during the period from January to April. This is attributed to several factors. As this is the dry season, the water in the fishpond is shallow and cannot be freshened often, hence the salinity and temperature are usually high so that the fish find themselves restricted in their movements and confined to places where the water is deep. They are also restricted in their feeding oftentimes since they cannot swim about freely to places where there is an abundance of lumut growth but where the water is usually shallow. During the rainy season, especially from August to October, their growth is very rapid. This is explained by the fact that the growth of lumut is also much faster during this period, hence there is greater abundance of algæ in the pond. Algæ seem to thrive well in fishponds where the water is brackish, especially during the rainy season. A greater depth of water enables the bañgos to go to the feeding grounds and to move around freely for exercise. Also, the temperature and salinity are such as to favor the proper development of the fish.

HARVESTING THE BAÑGOS

Harvest time in bañgos ponds varies widely according to the management and the locality. There are two plans in general use—namely, harvesting once a year and harvesting twice a year.

When the owner follows the method of harvesting bañgos twice a year, hatirin are placed in the kaluañgan during May or June and marketed from the end of September through Oc-

tober. Then the pond is drained, the ground prepared anew, and the pond restocked with garoñgin, which are harvested in April and May. The bañgos reared under this method reach a weight of 300 to 500 grams. Under this plan the owner should keep an impitan well stocked at all times with hatirin or garoñgin, ready to place in large empty ponds whenever they have been cleaned and have enough algæ to support the proper number of fish.

Under the other plan the fish are harvested during the latter months of the year when they weigh from 400 to 600 grams. The bañgos bring a higher price because they are comparatively larger.

Each method of growing and marketing bañgos has its advantages, and a fishpond owner should determine for himself which is the method best suited to the conditions in his locality.

CATCHING THE MARKETABLE BAÑGOS

During low tide, the water in the pond is reduced to about one-third, but at high tide water is again allowed to flow in. The water is so regulated in the kuluñgan that during catching time it is just about a meter in depth. As soon as the fish feel the inflowing current, they swim against it until they reach the catching pond. Here, they become eager to force their way against the gate, crowding one another half out of the water, and even leaping high in the air.

As soon as all the bañgos or as many as are wanted have entered the catching pond the gate between it and the kaluañgan is closed. The fish should then remain in the kuluñgan at least twenty-four hours before being caught. By that time the intestinal tract will be empty, and they will keep much longer than when caught at once while filled with food.

When sufficient time has elapsed, a seine (*saklit*) is dragged across the kuluñgan from end to end or from one side to another. During this operation there is great excitement. As the fish become crowded, they dart to and fro with great speed or leap high in the air. Frequently, they jump clear over the seine. Usually the seine is hauled to the bank and lifted section by section, the captured fish being placed in a banca. The pond is swept several times by the seine until all or practically all the bañgos are caught. Sometimes a gill net, called *kitid,* is also used to catch the bañgos in the kuluñgan. Only one man is required to handle this apparatus.

If the bañgos are placed in a banca they are transferred to large baskets when the boat is landed. The fish are

then laid out and sorted into standard sizes. All fish of other kinds, if any have been caught, are also placed in separate piles.

The fish are usually caught for market late in the evening or at night, so that they are in good condition for market the following morning. Around Manila Bay, the large producers put their bañgos in a motor boat, or in a large banca towed by a launch, and rush them to Manila, reaching there very early in the morning. Producers along the coast of Bataan pack their fish in ice and ship them to Manila on small local steamers. Fish from ponds at more-interior points in Bulacan and Pampanga and near railway stations are packed in ice and shipped by rail to adjacent provinces; such as, Tarlac, Pangasinan, Nueva Ecija, and Laguna. Some bañgos are also shipped by truck to neighboring towns.

Another method generally used for the capture of marketable bañgos in the Visayas is to construct a corral, or baclad, in the main pond, around the inner side of the gate. Sometimes it may be placed in the canal or creek outside the gate. If the baclad is outside the pond, the gate is opened at high tide when it is desired to catch fish. The bañgos swimming against the current pass through the gate and enter the baclad. As soon as the tide turns and the current slackens, the gate is closed, leaving the fish in the pound of the baclad. From this they are easily removed with a long-handled dip net. When the baclad is within the pond, doors are opened through which the fish can enter at high tide. These doors are closed at low tide, thus confining the fish within the baclad.

NATURAL ENEMIES OF THE BAÑGOS

Fish enemies.—It is very difficult to prevent the entrance of other kinds of fishes into bañgos ponds. Not only are certain kinds found mixed with the bañgos fry in the earthenware jars, but the young of many other kinds pass through the meshes of the bamboo screens when fresh salt water is admitted at high tide. Large fishes of certain kinds may be introduced carelessly and often produce eggs at once, which soon hatch into a horde of ever-hungry carnivorous fry. If the pond is near a bay or other large body of salt water, the killifish (*bubuntis*), gobies (*bia*) of many kinds, several species of eels (*igat, palos,* and *malabanos*), ambassid (*lañgaray*), spadefish (*kitang*), tarpon (*buan-buan*), sea bass (*apahap* and *lapo-lapo*), slip-mouth (*sap-sap*), halfbeak (*cansusuit*), grunt (*bagaong* and *ayuñgin*), ten-pounder (*bid-bid*), and other kinds are found in abundance.

Where the pond is at some interior point where it is flooded by fresh or only slightly brackish water, mudfish (*dalag*) and climbing perch (*liwalo*) are almost sure to enter. Most of the moderately small fishes referred to above are destructive to the kawag-kawag, hatirin, and garoñgin stages, but the others like the buan-buan, dalag, apahap, and other species of sea bass that grow to a larger size do much more harm to bañgos at all stages of growth.

Other enemies.—Among birds that feed upon young bañgos are egrets (*tagak*), terns (*kalañgay*), kingfishers (*kasay-kasay*), bitterns (*bakaw*), and the white-breasted sea eagle (*lawin*). Where the water in the pond is of low salinity, frogs may be found. These are harmful to the growing bañgos in the nursery pond. Several species of water snakes get into the fishponds through the gates and by crawling over the dikes. The commonest are *Disteira ornata* (Gray), *kalabukab,* and *Chersydrus granulatus* (Schneider), *malabasahan.* The snakes play havoc with the bañgos.

DESTRUCTIVE CRUSTACEANS FOUND IN THE FISHPONDS

Several kinds of shrimps usually occur in large quantities in bañgos ponds, especially the kind known as *sugpo.* Shrimps do no harm if they are not allowed to enter the nursery pond. Several species of crabs are found in bañgos ponds, and if of the best marketable kind may bring considerable revenue to the fishpond owner. In spite of the fact that crabs may contribute to the income, their presence in a bañgos pond is a source of more expense than revenue. They burrow holes in the dikes causing much loss of water and allowing water snakes, eels, dalag, and other enemies to get into the fishpond. Other burrowing crustaceans very harmful to fishpond dikes are sea mantes (*pitic-pitic*), sea scorpions (*oson*), and fiddler crabs (*bañgi-bañgi*).

CATCHING SHRIMPS

Of the aquatic animals that enter the ponds through the gates, the shrimps are the most welcome. They contribute to the income and their presence in a bañgos pond is a source of revenue.

Shrimps are attracted by light. When high tide occurs in the evening, water is admitted into the pond. Caretakers take this opportunity to let in as many shrimps as can be attracted to the gate by a fisherman's reflecting lamp suspended from the

bridge of the gate. The shrimps are carried inside the pond by the incoming water.

The usual method of admitting water into the pond is to allow it to flow over the top of the planks, but when shrimps are to be introduced the planks are raised, allowing the water to come in from below. The planks do not fall but are held in their respective positions by the lateral pressure of the water. The velocity of water is so great that shrimps lingering in the neighborhood of the gate are forced into the pond. This method has proved very effective with shrimps, which are known to be bottom swimmers.

Small traps modelled after large fish corrals but made especially for shrimps are set inside the ponds. They are known as *bakikong* or *umang*. The leader (*painpin*) is set at right angles to the dike which it touches. The umang is made of baclad or woven split bamboo. The shrimps are caught in the pound by a dip net provided with a long pole.

POSSIBILITY OF CULTIVATING MULLET, OR BANAK, WITH BAÑGOS

There are about twenty kinds of mullets in Philippine waters; some are exclusively marine, but most of them occur in both fresh and salt water. Like the bañgos they are practically toothless and feed largely upon organisms contained in the surface layer of bottom mud, as well as upon algæ. They are sometimes mistaken for bañgos, but are at once distinguishable by having two dorsal fins as well as a broad snout.

Mullets are represented by two groups in the Philippines. Those with the eye covered by a thick transparent tissue, called the adipose eyelid, belong to the genus *Mugil;* the others, coming under the genus *Liza,* are distinguished by not having an adipose eyelid. Some Philippine species have no commercial value because of their small size, but one species, *Mugil cephalus* Linnæus, or gray mullet, which reaches a considerable size, has been known to be cultivated extensively and successfully in India, Japan, Formosa, and other Oriental countries. The sides of this fish are marked by dark but not very evident longitudinal stripes along the rows of scales. The gray mullet is very common in the Philippines. It is much superior to bañgos in flavor and is free of fine bones, and being a strict vegetarian should thrive in the same pond with bañgos. As has been observed in some fishponds in Japan and Formosa, the gray mullet can be fed with prepared food; such as, sweet potato (*camote*), rice bran, etc.

A MODEL TEN-HECTARE FISH FARM

The size and shape of a fish farm are governed by the area and the configuration of one's property. Established practice requires certain definite proportions in the size of the ponds. A fish farm of about 10 hectares should have four ponds; namely, the kulunggan, pabiayan, impitan, and kaluanggan (figs. 8 and 9). The impitan should be made about one-tenth of the whole farm, or 1 hectare. The pabiayan is but a small portion of the impitan, and it should cover one-seventeenth to one-twentieth of its

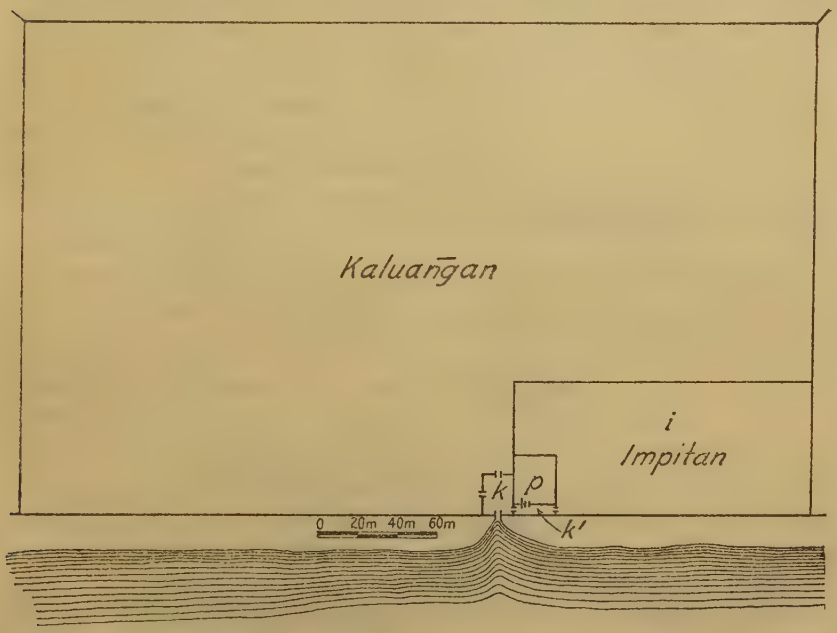


FIG. 8. Plan of ideal 10-hectare fish farm (400 by 250 meters); *k*, kulunggan; *k'*, kulunggan for ponds *p* and *i*; *p*, pabiayan.

area. A space of about 300 square meters is the proper size for the kulunggan. The rest of the 10 hectares is the kaluanggan.

As has been previously stated, a hectare of pabiayan can carry 500,000 banggos fry at one time, or 50 fish to a square meter. A 10-hectare fish farm should have a pabiayan that will accommodate from 25,000 to 30,000 fry for stock. Allowing 40 per cent mortality in the pabiayan due to the havoc caused by enemies and to the varying effects of the physical factors during the period of acclimatization, the number of fingerlings that can survive is from 15,000 to 18,000. The young fish are then transferred into the impitan, where they are either retained for an indefinite period or allowed to grow sufficiently large to with-

stand adverse conditions in the kaluañgan. In the impitan the fish enemies are more or less under control, as in the pabiayan, and because of the larger size of the growing bañgos and their ability to escape readily from their enemies, the mortality is much less, usually not over 15 per cent. After making due allowance for mortality, the number that can be carried into the kaluañgan is from 12,500 to 15,000. On account of the presence of enemies of different kinds and sizes, and of other destructive factors, the mortality in this pond may be as high as 30 per cent so that the number of bañgos harvested would be from

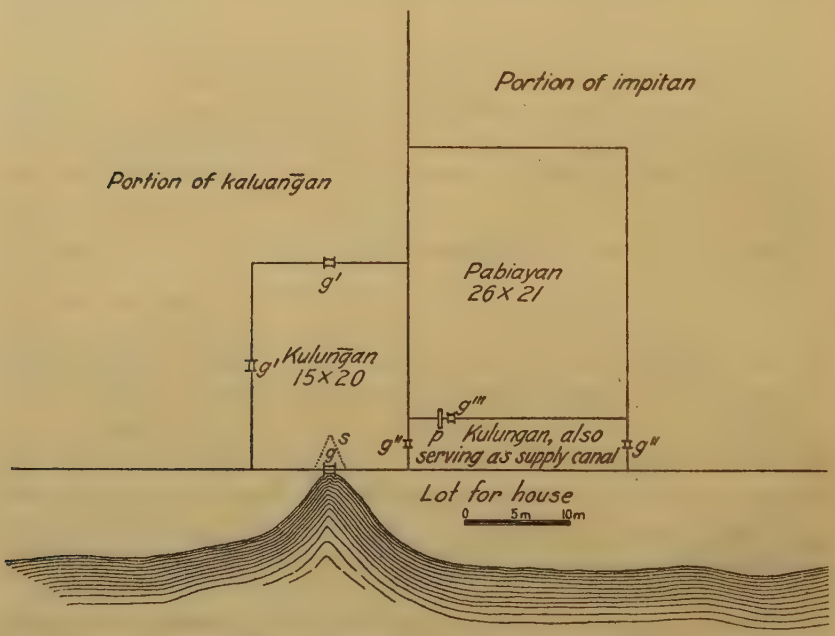


FIG. 9. Details of kuluñgan and pabiayan; *g*, main gate; *s*, saplad; *g'*, secondary gate; *g''*, gate of wood or concrete smaller than *g'*; *g'''*, gate of wood smaller than *g''*; *p*, pansol.

9,000 to 11,000, or 900 to 1,100 per hectare. From the above figures, it is advisable that in order to obtain the best results the number of bañgos fry used for stocking a 10-hectare fish farm should not exceed 30,000.

In the case of smaller farms, the pabiayan can be done away with. The impitan properly prepared will serve the purpose. In a fish farm of less than a hectare, the kuluñgan, impitan, and pabiayan are not necessary if the stock available consists of fingerlings. Where the supply consists only of fry, it is

advisable to have at one corner a small nursery of only one compartment.

GLOSSARY

ALGÆ. Organisms belonging to the lowest division of the vegetable kingdom, comprising seaweeds, pond scums, and a great variety of plants invisible to the naked eye inhabiting fresh and salt water in countless numbers.

AMBASSID. Small translucent fish, called lañgaray in Tagalog, destructive to young bañgos in the nursery ponds.

ANAHAW. Local name for *Livistona*, a kind of palm, the trunk of which is used for supply and drain pipes in the nursery ponds.

APAHAP. *Lates calcarifer* (Bloch), a member of the sea bass family, the worst enemy of the bañgos, being voracious and carnivorous.

APRON. A continuation of the floor of a headgate at each side to prevent undercutting of water.

AWA. Ilocano, Visayan, and Pangasinan name for full-grown bañgos.

AWA-AWA. Visayan name for bañgos fry.

AYUÑGIN. Tagalog name for grunt, *Therapon argenteus* (Cuvier and Valenciennes), a species occurring both in salt and fresh water, and destructive to bañgos fry.

BACTERIA. Extremely minute organisms, occurring as refuse eaters and as parasites.

BAGAONG. A grunt, *Therapon jarbua* (Forskål), a fish harmful to young bañgos.

BAKAWAN. Tagalog name for mangrove.

BAKAW. Tagalog name for bittern, a bird harmful to bañgos.

BAKIKONG. Trap to catch shrimps; also called umang.

BANAK. Tagalog name for mullet, a kind of fish entering fishponds and possessing habits similar to the bañgos.

BAÑGI-BAÑGI. Visayan name for fiddler crab, a burrowing crustacean destructive to fishpond dikes.

BANGLIS. Tagalog name for bañgos.

BAÑGILIS. Samal and Tao Sug name for bañgos.

BANGLUS. Visayan name for bañgos.

BANGRIS. Tagalog name for bañgos.

BAÑGOS. Tagalog, Ilocano, Pampango, and Bicol name for milkfish.

BANGROS. Visayan name for bañgos.

BANSUTAN. The second or largest compartment in a nursery system where young bañgos, or hatirin, are retained for two months or longer until they are large enough for planting in the kaluañgan, or rearing pond.

BERM. Space between the dike and borrow pit.

BETEL. Pangasinan name for bañgos.

BIA. Tagalog name for goby, which refers to small carnivorous fishes of the family Gobiidæ, destructive to young bañgos.

BID-BID. Ten-pounder, *Elops hawaiiensis* Regan, a swift, rapidly growing, voracious, carnivorous fish very destructive to bañgos.

BITINAN. A dip net, usually rectangular in shape, partly immersed in water, where hatirin, or fingerlings, are counted.

BITTERN. A bird, called bakaw in Tagalog, destructive to young bañgos.

BOBO. A fish trap, basketlike affair, made of woven bamboo splints.

BORROW PIT. Marginal canal in the fishpond from which mud is taken to make the dike.

BUAN-BUAN. Tarpon, *Megalops cyprinoides* (Broussonet), a voracious and carnivorous enemy of the bañgos.

BUBUNTIS. Tagalog name for killifish, *Mollienisia latipinna* Le Sueur, an introduced species harmful to young bañgos by feeding on the same kind of food.

BUGUI. Ilocano name for bañgos fry.

CAHIG. Visayan name for a small brush used to remove dirt from the basin containing bañgos fry.

CAMOTE. Sweet potato.

CANSUSUIT. Tagalog name for halfbeak.

CHANOS CHANOS. Scientific name of bañgos.

CHERSYDRUS GRANULATUS. Scientific name of a species of water snake, called malabasahan in Tagalog.

COLONIAL. Of, pertaining to, or being a colony or colonies.

COWRIE. A kind of sea shell, known locally as sigay.

CRUSTACEA. A class of animals to which crayfish, lobsters, shrimps, prawns, crabs, and the like belong.

CUGAO. Visayan name for bañgos.

DALAG. Tagalog name for mudfish, *Ophicephalus striatus* Bloch, one of the most dangerous enemies of the bañgos, being voracious and carnivorous.

DIATOMS. A class of one-celled algæ inhabiting fresh and salt water.

DIGMAN. Tagalog name applied to various hydrophytic plants occurring in fishponds.

DISTEIRA ORNATA. Scientific name of a species of water snake, called kalabukab in Tagalog.

EAGLE. A bird, called lawin in Tagalog, destructive to bañgos.

EEL. A snakelike fish, known locally as ogdoc, igat, or palos, which enters fishponds and feeds on young bañgos.

EGRET. A bird, called tagak in Tagalog, destructive to bañgos.

FIDDLER CRAB. A crustacean, called bañgi-bañgi in Visayan, destructive to fishpond dikes.

FILAMENTOUS. Like, consisting of, or bearing threads or filaments.

FINGERLING. Young bañgos fingerlike in size, called hatirin and garoñgin in Tagalog, which vary in length from 5 to 12.5 centimeters.

FRY. Very young bañgos, called kawag-kawag or kakawag in Tagalog, taken along the coasts in many parts of the Islands for planting in fishponds; known also as bugui, awa-awa, and semilla.

GALAO. An elongate, fine-meshed, woven-bamboo basket, shaped like certain types of fish traps, or bobo, wrapped in sinamay cloth to serve as a screen with the object of keeping the enemies of young bañgos out of the nursery.

GAROÑGIN. Tagalog name for young bañgos of fingerling size, usually 10 to 12.5 centimeters long.

GOBY. Small carnivorous fish of the family Gobiidæ, called bia in Tagalog, destructive to young bañgos.

HALFBEAK. Fish with produced snout, the upper part of which is much shorter than the lower, called cansusuit in Tagalog; harmful to young bañgos.

HATIRIN. Young bañgos of fingerling size, usually 5 to 10 centimeters long.

HYDROPHYTIC. Living in water; pertaining to plants living in water.

IMPITAN. The largest subdivision in a nursery system where the young bañgos, or hatirin, are held about two months or longer until large enough for planting in the kaluañgan, or rearing pond.

IGAT. Fresh-water eel.

KAKAWAG. Tagalog name for bañgos fry.

KALABUKAB. A water snake, *Disteira ornata* (Gray), destructive to bañgos.

KALAÑGAY. Tagalog name for tern, a bird harmful to young bañgos.

KALUAÑGAN. The rearing pond where bañgos are allowed to grow to marketable size.

KASAY-KASAY. Tagalog name for kingfisher, a bird destructive to young bañgos.

KAWAG-KAWAG. Tagalog name for bañgos fry.

KITANG. A well-flavored fish, *Scatophagus argus* (Gmelin), abundant in rivers and estuaries, sometimes found in fishponds; being vegetarian it does no harm to the bañgos and its presence is not objectionable.

KITID. A small gill net used to catch marketable bañgos in the kuluñgan.

KULUÑGAN. The catching pond.

LAB-LAB. Tagalog name for the plant complex forming a crust or mat upon the floor of the nursery pond, composed largely of unicellular, colonial, and filamentous blue-green algæ; it contains also diatoms, bacteria, some unicellular and filamentous green algæ, many Protozoa, minute worms, and small Crustacea.

LAÑGARAY. Tagalog name for ambassid, a small and very bony, semitransparent, silvery fish destructive to bañgos fry.

LAON. Name referring to bañgos, especially to the fish that have remained a year or longer in the fishpond.

LAPO-LAPO. Sea bass, one of the worst enemies of the bañgos.

LAWIN. The white-breasted sea eagle, an enemy of the bañgos.

LIA. Duckweed, a kind of floating water plant found in some fishponds.

LIVISTONA. The generic name of a palm, the wood of which, called luyong in Tagalog, is used for supply and drain pipes in the nursery ponds.

LIWALO. The climbing perch, *Anabas testudineus* (Bloch), a harmful enemy of young bañgos.

LIZA. Generic name of a group of mullets having no adipose eyelid.

LUMULUKSO. Tagalog name for full-grown bañgos noted for their astounding leaping powers.

LUMUT. Filamentous algæ.

MALABANOS. Marine eel; a moray.

MALABASAHAN. A species of water snake, *Chersydrus granulatus* (Schneider), harmful to bañgos.

MECHA. Puddle trench, or trough, dug in the middle of the main dike along its entire course.

MORAY. A kind of marine eel.

MUDSKIPPER. A kind of goby, called talimosak in Tagalog, that feeds on bañgos fry.

MUGIL. Generic name of a group of mullets possessing an adipose eyelid.

MUGIL CEPHALUS. The scientific name of the gray mullet.

MULLET. A fish sometimes mistaken for bañgos; strictly vegetarian, living largely on the minute organisms contained in the layer of mud at the bottom of the nursery pond.

OSON. Visayan name for sea scorpion, a crustacean boring holes through fishpond dikes.

PABIAYAN. The first small compartment in the nursery system, where bañgos fry are reared for the first month or six weeks.

PAINPIN. The leader of the trap used to catch shrimps in fishponds.

PALAKIHAN. Another name for impitan or bansutan.

PALAPAT. Tagalog name for a tree, *Sonneratia*, growing in mangrove swamps.

PALOS. Tagalog name for marine snake eel.

PALYOK. The low, wide-mouthed, pot-bellied, unglazed, earthenware jar used as a container for the transportation of bañgos fry.

PAMANDAWAN. Large boat, or banca, employed to transport bañgos fingerlings from the nursery ponds in Dampalit to fishponds in other localities.

PAMATID. Partition dike dividing a rearing pond into two or more compartments.

PANAGAP. A fine-meshed seine of cotton, similar to the sagap, employed to catch hatirin.

PANSIMOT. The lower of the two pipes in the pabiayan, which is used to drain the water off completely when it is desired to dry the pond.

PANSOL. Pipe made of the trunk of the anahaw palm, *Livistona*, employed in the nursery ponds for drainage and intake.

PATID. To cut or short cut.

PITAS. Temporary gate cut at certain portion in the partition dike used as passage for fish from one compartment to another.

PITIC-PITIC. Visayan name for sea mantis, a burrowing crustacean destructive to fishpond dikes.

POLYGON. A plane or closed figure having more than four angles.

PROTOZOA. A primary division of the animal kingdom, embracing organisms consisting of a single cell or groups of cells not separable into different tissues.

PUDDLE TRENCH. A trough, or "mecha," dug in the middle of the main dike along its entire course.

QUADRANGULAR. Having four sides and four angles.

SABALO. Full-grown bañgos; lumulukso.

SAGAP. A small seine of sinamay, employed to catch bañgos fry.

SAKLIT. A large seine employed to catch marketable bañgos in the kuluñgan.

SALA-AN. A sieve of wire netting, used to separate bañgos fry from the fry of other fishes.

SANGKA. A canal in the fry-pond system.

SAPLAD. A trap similar to the fish corral, or baclad, employed to catch bañgos fry.

SAP-SAP. Small, silvery fish, very much compressed, and able to protrude the mouth to a remarkable extent; found sometimes in fishponds.

SAYOD. Ilocano name for the small seine, or sagap, for catching bañgos fry.

SCATOPHAGUS. Generic name for kitang.

SEA MANTIS. A burrowing crustacean, destructive to fishpond dikes; known as pitic-pitic in Visayan.

SEA SCORPION. A burrowing crustacean, destructive to fishpond dikes; called oson in Visayan.

SEMILLA. Local name for bañgos fry.

SIGAY. Local name for cowrie; used for counting bañgos fry.

SINAMAY. Native cloth made of abacá fiber.

SLIP-MOUTH. Known locally as sap-sap; a small, silvery, and compressed fish, able to protrude its mouth in a singular manner.

SONNERATIA. A kind of tree growing in mangrove swamps, called palapat in Tagalog.

SPADEFISH. A dark-spotted, deep-bodied, much-compressed fish, called kitang in Tagalog.

SUGPO. A kind of shrimp entering fishponds.

TAGAK. Tagalog name for egret, a bird harmful to young bañgos.

TALIMOSAK. A kind of goby destructive to young bañgos, common in mud flats, mangrove swamps, and muddy estuaries; well known for its leaping powers.

TEN-POUNDER. Known as bidbid in Tagalog, or *Elops hawaiiensis* Regan, a very destructive enemy of the bañgos.

TERN. A bird, called kalañgay in Tagalog, harmful to bañgos.

TIKITIKI. Rice bran.

TINIDTID. Crushed bamboo employed in fish trap, or saplad, for catching bañgos fry.

UMANG. Small trap modelled after a fish corral, used for catching shrimps; also called bakikong.

UNICELLULAR. Consisting of a single cell; one-celled.

ILLUSTRATIONS

PLATE 1

Bañgos, or milkfish, *Chanos chanos* Forskål; about × 0.5.

PLATE 2

FIG. 1. Bañgos fry, or kawag-kawag; × 8. Actual length, 10 millimeters.
2. Roe of bañgos containing over 3,000,000 eggs.

PLATE 3

FIG. 1. Catching bañgos fry with sagap. Barrio Calala, San Jose de Buenavista, Antique Province.
2. Another view showing catching of bañgos fry with sagap. Barrio Calala, San Jose de Buenavista.

PLATE 4

FIG. 1. Catching bañgos fry with saplad. Barrio Calala, San Jose de Buenavista.
2. Counting bañgos fry. Barrio Calala, San Jose de Buenavista.

PLATE 5

FIG. 1. Bañgos fry in earthenware jars ready for sale. Barrio Calala, San Jose de Buenavista.
2. Fishpond site cleared of nipa palms and mangrove trees. Pilar, Bataan Province.

PLATE 6

FIG. 1. Catching shrimps in corral inside pond.
2. Partial view of fish farm showing pabiayan in the foreground, impitan at the left, and kaluañgan in the foreground. Orani, Bataan Province.

PLATE 7

FIG. 1. Fish farm at Balamban, Cebu Province.
2. Fry-pond system showing a series of six pabiayan and canal. Orani, Bataan.

PLATE 8

FIG. 1. Fishpond with an excellent growth of algæ. Carlos Palanca estate, Hagonoy, Bulacan Province.
2. Banca load of jars of bañgos fry towed by motor boat from Manila to the Carlos Palanca estate, Hagonoy, Bulacan Province, and Masantol, Pampanga Province.

PLATE 9

FIG. 1. Discarding dead bañgos fry and making the number of fish uniform in the various jars. Carlos Palanca estate, Hagonoy and Masantol.

2. Catching young bañgos (garoñgin). Net (bitinan) is not lifted from the water. Fish are released in the large pond as counted. Ayala estates, Macabebe, Pampanga Province.

PLATE 10

FIG. 1. Constructing a dike. Camus Brothers' fish farm, Dagatdagatan, Caloocan, Rizal Province.

2. Repairing dike. Camus Brothers' fish farm, Dagatdagatan, Caloocan.

TEXT FIGURES

FIG. 1. Cross section of main dike showing puddle trench, berm, borrow pit, and floor of pond.

2. Schematic sketch showing kuluñgan, head gate, saplad, and secondary gate in background.

3. Details of head gate.

4. Fish-farm layout, showing the effectiveness of pamatid in creating circulation of water in the kaluañgan; *g*, main gate; *g'*, gate of wood or concrete smaller than *g*; *s*, saplad.

5. Another type of fish-farm layout; *g*, main gate; *s*, saplad; *g'*, gate of wood or concrete smaller than *g*.

6. Fry-pond system; *k-k'*, kuluñgan; *p-p'*, pansol; *qp*, quadrangular pipe; *sg*, small wooden gate.

7. Cross section of dike separating pabiayan from kuluñgan showing the position of pansol and galao.

8. Plan of ideal 10-hectare fish farm (400 × 250 meters); *k*, kuluñgan; *k'*, kuluñgan for ponds *p* and *i*; *p*, pabiayan.

9. Details of kuluñgan and pabiayan; *g*, main gate; *s*, saplad; *g'*, secondary gate; *g''*, gate of wood or concrete smaller than *g'*; *g'''*, gate of wood smaller than *g''*; *p*, pansol.

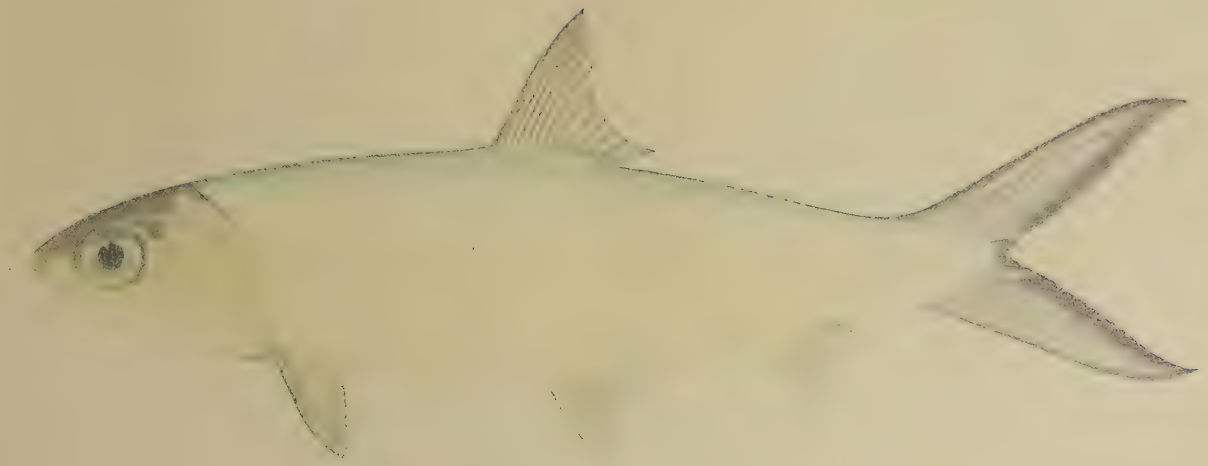
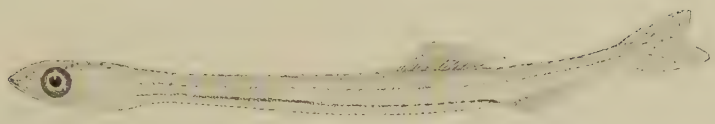


PLATE 1. BAÑGOS, OR MILKFISH, CHANOS CHANOS FORSKÅL.



1

2

PLATE 2.

1

2

PLATE 3.

1

2

PLATE 4.

1

2

PLATE 5.

1

2

PLATE 6.

1

2

PLATE 7.

1

2

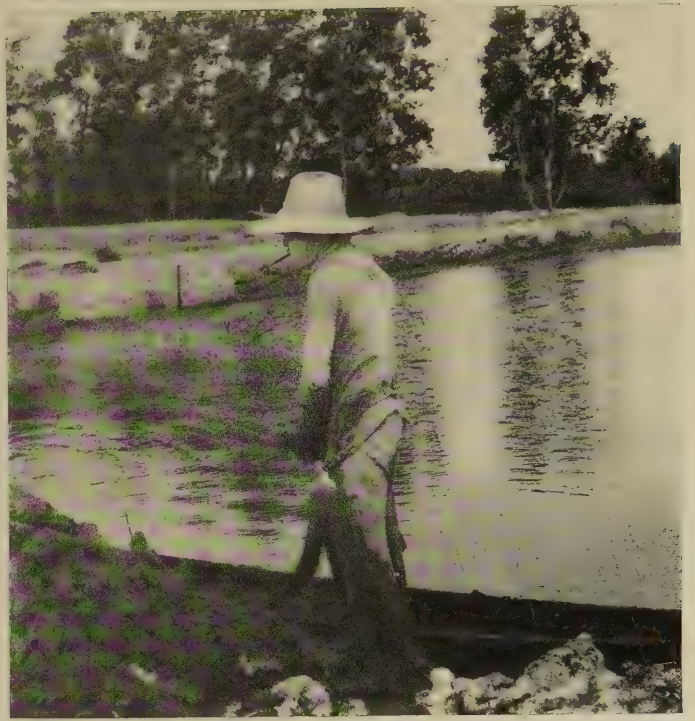
PLATE 8.

1

2

PLATE 9.

1



2

PLATE 10.

CEPHALOPODS OF THE GENERA SEPIOLOIDEA, SEPIADARIUM, AND IDIOSEPIUS

By S. Stillman Berry
Of Redlands, California

ONE PLATE

Since the manuscript of my "Review of the cephalopod genera Sepioloidea, Sepiadarium, and Idiosepius" (Berry, 1921) left my hands to go to the Australian publishers, an unexpected amount of additional information regarding several of the species belonging to these peculiar genera has been acquired, a digest of which is here offered by way of a needful supplement to the previous paper. In this connection my grateful thanks are due to the late Prof. Madoka Sasaki, of the Hokkaido Imperial University, for generously placing several valuable lots of material at my disposal; to Mr. William F. Clapp, of the Museum of Comparative Zoölogy, for the loan of a series of *Sepiadarium* from Hongkong; and to Dr. Theodor Mortensen, of the Universitetets Zoölogiske Museum at Copenhagen, for kindly supplying information regarding certain of the classical Steenstrupian specimens preserved in the collections of that institution.

Meanwhile attention should be called to several recent publications (cited in full at the end of this paper) that deal to some extent with these little squids, among which those of Grimpe, 1920, and Sasaki, 1923, especially should be noticed. For more complete references to the older literature than are given herein, reference may be made to my former paper above cited.

SEPIOLOIDEA AND SEPIADARIUM

Evidence seems to be increasing (characters of the radula, etc.) that *Sepioloidea* and *Sepiadarium* do not after all possess the close affinity that has been supposed with the members of the family Sepiolidæ, to which superficially they seem so similar, but that the subfamily Sepiadariinæ may require transfer to the Idiosepiidæ or else, as a possible alternative, elevation to the rank of an independent family as Fischer, 1882 (p. 350), once treated them.

SEPIADARIUM KOCHII Steenstrup, 1881.

Sepiadarium kochii STEENSTRUP, K. D. Vid. Selsks. Skr. (6) 1 (1881) 218, 235 [8, 25], pl. 1, figs. 1–10.

Sepiadarium kochii BERRY (pars), Rec. So. Austral. Mus. 1 (1921) 349, 351, 355, chart 10 (mention of *kochii* on p. 358 an error).

Descriptive notes.—The courteous loan from the Museum of Comparative Zoölogy at Harvard College of three of the specimens of this species from Hongkong previously noted (Berry, 1921, p. 353, No. 269) enables me to confirm the observations of Steenstrup in several important particulars and in a few respects somewhat to amplify them, although at the same time a few small discrepancies are to be noted.

One of the principal disagreements is with respect to the relative order of length of the arms, which Steenstrup distinctly states (1881, p. 216) to be of the formula 1, 3, 4, 2, whereas in the Harvard specimens, as is brought out in the accompanying table of measurements, the third pair is always slightly, but distinctly, the longest, and the general arm formula is best written 3, 1 = 2, 4, or 3, 1, 2 = 4. This circumstance necessitates a slight correction in the tentative key offered in my former paper (p. 351).

The length of the fins is another variable, the longest fin of the largest female being over half as long as the mantle, thus approaching the condition described for Robson's *auritum*.

The arm suckers of the female are small, with moderate-sized pyriform apertures relatively much more ample than those of the larger corresponding suckers of the male. In two series for the most part (that is, about eighteen pairs on an arm of the third pair), the rows are separated, except at the base of the arm, by a distinct flattened bare area as wide or wider at its broadest part than the suckers themselves. At the extreme tip of the arm the suckers are much reduced and crowded into four rows.

The arm suckers of the male are nearly spherical, relatively larger than in the female and with very small pyriform apertures. Over most of the arm (nine to ten pairs) they are in two series, but at the tip become much reduced and crowded into about four series. The rows are nowhere separated by a median bare area.

The nuptial arm is the left ventral. Here the proximal half of the arm is normal, with some eight pairs of normal suckers. The distal half of the arm is strongly recurved or half-coiled dorsad, its suckers entirely atrophied and their place taken by

what must be interpreted as their highly modified bases, enlarged and coalesced into a series of fleshy, obliquely transverse ridges, about eighteen in number, each divided by a distinct longitudinal furrow along the ridge into two quite distinct elevations. The summit of each of these elevations is drawn out into a sort of papilla, with that on the ventral side in each case the more proximal in position as well as somewhat the larger. A low subangulate ridge parallels the modified area a little way from it, forming here the dorso-oral angle of the arm, but there is no other evidence of a dorsomarginal web. The ventromarginal web is strongly developed as a wide fleshy crenulated vertical membrane a little higher than the transverse ridge over against which it lies, and with which it is connected by stout trabeculæ arising distally from the ventral division of each transverse ridge and passing out between it and the ridge next in front.

TABLE 1—*Measurements of Sepiadarium kochii Steenstrup.*

	Author's register No.		
	269, ♀	269, ♀	269, ♂
	mm.	*mm.*	*mm.*
Total length	38	38	28
Length of body, dorsal	18	16	14
Length of body, ventral	20	14	16
Tip of body to base of dorsal arms	25	21.5	19
Width of fin at widest point	4	3.5	2.5
Length of fin	11.5	7	7
Width across fins	22.5	18	14
Width of body	16	13.5	10.5
Depth of body	14	9	8
Width of head across eyes	13	11	10
Length of head (nuchal commissure to base of dorsal arms)	7	5.5	5
Length of exposed portion of funnel	2	7	1.5
Length of right dorsal arm	10	11	8
Length of left dorsal arm	10	11	8
Length of right second arm	10	12	7.5
Length of left second arm	10	12	7.5
Length of right third arm	11	13	9
Length of left third arm	11	15	9
Length of right ventral arm	9	10.5	8
Length of left ventral arm	+6	10.5	8
Length of right tentacle	14	(a)	13
Length of right tentacle club	4	----------	3
Length of left tentacle	(a)	19	9
Length of left tentacle club	----------	4	3

[a] Mutilated.

The tentacle club has about six (male) to eight (female) indistinct series of very minute suckers and a wide keel.

The mantle margin is sometimes slightly crenulate, but not (in these specimens) digitate near its juncture with the body.

The radula (female) has strongly developed rhachidian teeth with squarish bases and single long, acute central cusps. The first laterals are minute, overhanging, with a short acute median cusp and only the weakest possible hint of side cusps. The second laterals are very broad at the base, which is strongly produced, as though by an accessory cusp, toward the major laterals, the principal cusp about half again as long as the adjoining first lateral, stout, acute, and somewhat attenuated. The major laterals are stout, strongly falcate, somewhat longer than the rhachidians.

Type locality.—At my request Dr. Theodor Mortensen kindly looked up Steenstrup's original material of this species, and writes definitely that, as has been presumed, the type specimen in the Universitetets Zoologiske Museum comes from Hongkong.

Distributional note.—The records of *kochii* from Japanese waters should probably be deleted in toto, as all specimens seen from that region appear to belong to the following distinct species. Some of the Ceylonese and East Indian records would also perhaps bear a critical reëxamination.

SEPIADARIUM NIPPONIANUM sp. nov.

Sepiadarium kochii SASAKI, Zool. Mag. Tokyo (1913) 247, fig. 2 (text in Japanese), not of Steenstrup, 1881.

Sepiadarium kochii SASAKI, Annot. Zool. Japon. 8 (1914) 597.

Sepiadarium kochii BERRY (pars), Rec. So. Austral. Mus. 1 (1929) 351, 352, chart 10 (probably all of the Japanese records).

Sepiadarium kochii M. ISHIKAWA, Journ. Coll. Agr. Im. Univ. Tokyo 7 (1924) (167), 182, pl. 10, fig. 36.

Diagnosis.—Body small, sepioliform, comparatively short and rounded posteriorly. Fins rather small, attached behind the middle; their maximum length 40 to 53 per cent that of the mantle; in outline semicordate, with a fairly strong anterior and weak posterior lobe. Mantle united with head by a nuchal commissure about half as wide as the body; its free margin somewhat emarginate below the funnel and usually showing a slight, foldlike notch on either side of the commissure, though without traces of true crenulation or digitation in the type material.

Head large, about as wide as the body. Eyes large, with the usual crescentic lid folds. Funnel moderately long, reaching two-thirds or more of the distance from the mantle margin to

the cleft between the ventral arms, thick-walled and fleshy, its interior with a small, rounded-triangular, flaplike valve near the apex; funnel organ comprising a large chevron-shaped dorsomedian member and a pair of more or less pyriform ventrolateral pads.

Sessile arms rather short, their order of relative length somewhat variable in preserved specimens, but the third pair quite distinctly the longest and the formula as a whole usually 3, 2, 1, 4, the dorsal and ventral arms being nearly of a length; in some specimens the arms of the second pair are distinctly the shortest. Suckers small, rounded kidney-shaped, with small, projecting, roundish apertures; those on proximal half of arms in two well-separated rows (comprising eight or nine pairs on dorsal arms, nine or ten pairs on remaining arms), the third to seventh or fourth to seventh pairs quite distinctly the largest; on the distal half of the arms suddenly reduced in size and crowded into four rows; two or three basalmost pairs of suckers on all arms distinctly smaller than those succeeding and the apical suckers minute again; the two series of suckers on the proximal part of the arm well separated but showing no conspicuous flattened bare area between, even in the female. Nuptial arm the left ventral; proximal half of arm normal, bearing about eight pairs of normal suckers; distal half somewhat excavated and curved to the left, its suckers replaced by a series of about twenty-four fleshy transverse ridges, evidently formed by coalescence of the thickened bases of the entirely atrophied suckers, each ridge being distinctly bipapillose at the summit, and connected at its ventrodistal angle with the nearly obsolete ventral web by a sort of fleshy trabeculum; toward the tip of the arm the web seems better developed in relation to the ridges but nowhere succeeds in encroaching very much upon them; a subangulate ridge parallels the hectocotylized area a little way from it, forming the dorsal angle of the arm in this region, but there is no dorsal web.

Tentacle rather less robust than the arms and from about half again to nearly twice their length; the club short, strongly keeled, with numerous minute suckers, which on the central portion appear to rank in about eight scarcely defined rows, and seem everywhere nearly uniform with only very gradual gradation in size.

Radula with stout rhachidian teeth having long, acute, somewhat attenuated cusps arising from rectangular bases; first laterals very small and short, with a short, stout major cusp,

which is continued out into a minute accessory cusp on the inner margin; second laterals again much larger, very broad and overhanging, with a single wide, acute cusp; major laterals long and strongly falcate; marginal plates extremely minute, pyriform.

TABLE 2.—*Measurements of Sepiadarium nipponianum sp. nov.*

	Author's register No.			
	724, ♂, type.	725, ♂, paratype.	725, ?, paratype.	725, ♀, paratype.
	mm.	*mm.*	*mm.*	*mm.*
Total length	32	40+	42	45
Length of body, dorsal	11	16.2	16	15
Length of body, ventral	10	14.5	14	13.5
Tip of body to base of dorsal arms	16	21.7	22	21
Width of fin at widest point	2.5	3.5	3.5	3.5
Length of fin	6.5	6.4	7.6	8
Width across fins	15	18	19	18
Width of body	10.4	13.5	12	11.3
Depth of body	7.6	8.2	10	10
Width of head across eyes	9	11.4	11	11.5
Length of head (nuchal commissure to base of dorsal arms)	5	5.7	6	6
Width of nuchal commissure	5.4	5.5	5	5.5
Length of exposed portion of funnel (median)	4.5	6.6	5	5
Length of right dorsal arm	9.6	16	12.5	11.2
Length of left dorsal arm	9.6	16.7	12.5	11.6
Length of right second arm	10.6	----------	10+	12
Length of left second arm	10.7	13+	13.5	11.5+
Length of right third arm	12	12+	14.3	13
Length of left third arm	12	13	14.5	11+
Length of right ventral arm	9.5	14.7	11.5	10.4
Length of left ventral arm	9	13.6	11.2	12
Length of right tentacle	----------	----------	20	24
Length of right tentacle club	----------	----------	4	4
Length of left tentacle	15	----------	18	23
Length of left tentacle club	2.5	----------	4	4

Type.—A male in the author's collection (S. S. B. 724). A paratype is to be deposited in the South Australian Museum and another has been returned to Prof. Madoka Sasaki (725).

Type locality.—Sagami Bay, Japan; Madoka Sasaki collector, April 10, 1918; 2 males, 6 males.

Recorded distribution.—JAPAN,[1] Sagami Bay!; Enoura, Suruga (*Sasaki*); off Nukumi, Satsuma (*Sasaki*); Beppu, Bungo

[1] I refer here all Japanese records published as *S. kochii.* Were there more than one species of *Sepiadarium* represented in the Japanese collections it would seem as though the numerous keen students of that nationality would have detected them.

(*Sasaki*); Kurihama, Musashi (*Sasaki*); Nagasaki (*Sasaki*); Fukue, Mikawa (*M. Ishikawa*).

Remarks.—In my former paper the suggestion was made that the discrepancies to be noted between the original figures of *S. kochii* Steenstrup and Sasaki's account of his Japanese specimens of *Sepiadarium* are such as to indicate the possibility of more than one species being involved. Since then the friendly contribution by Professor Sasaki of some of his own material has enabled a direct comparison with the specimens of true *kochii* from Hongkong previously noted, with the result that I find my surmise measurably confirmed. Although inconspicuous at first glance the differences observed are reasonably uniform, are in accord with the published observations of Sasaki on his more ample Japanese material, and seem amply sufficient to justify the present separate recognition of the Japanese form. To sum up, *nipponianum* is very close in most characters to *kochii*, but the specimens can be readily separated by the fact that in the females of *kochii* there is a distinct space free of suckers down the middle of the median portion of the arm which is represented in the Japanese species merely by an incipient separation of the rows, and the fact that in the males of *nipponianum* the transverse ridges of the nuptial arm are more conical, more distinctly papillose, more elevated, and more numerous.[2] The relative lengths of the arms are likewise somewhat different, and there are differences in the details of the radula, notably in the shape of the second lateral teeth. No doubt if this interpretation of the facts be well conceived, further characters of import will be brought to light by the examination of more and better material than that now in hand.

Returning to the radula, it may be said that this organ is in general quite like that of *kochii* as would be expected, but there seem to be too many small differences to find their entire explanation in individual variation. The relative stoutness and great width of the second laterals in the present species are probably characteristic, yet it would doubtless be as well to check up these points with more ample material before placing too much reliance upon them. Unless very strongly stained with some such medium as chromic acid the exact form of the teeth is quite difficult to make out in mounted preparations. The radula of *Sepiadarium*, especially in the relative complexity of the first lateral and major lateral teeth, recalls the Loliginidæ

[2] Although it must be admitted that Steenstrup's original figure of *kochii* shows as many.

much more than either the Sepiolidæ (*Rossia, Euprymna,* etc.) or the Sepiidæ, where the dentition is of a much simpler type.

The arm and tentacle complex of this species has already been figured by Sasaki, 1913, fig. 2.

IDIOSEPIUS

Much still remains to be worked out before we can feel certain of the exact natural position and relationships of this small but highly specialized and interesting genus. Grimpe, 1920, referred his segregate *Naefidium* to the Loliginidæ, establishing therein to receive it a new subfamily Naefidiinæ. However, in a postscript to the same paper he later restored it to the Idiosepiidæ. Naef, 1921, places the family without question in his major group Sepioidea. In the phylogenetic tree that has been worked out on the basis of statocyst structure, *Idiosepius* stands rather alone, the adult organ remaining in a somewhat primitive condition.

IDIOSEPIUS PYGMAEUS Steenstrup, 1881.

Idiosepius pygmaeus STEENSTRUP, K. D. Vid. Selsk. Skr. (6) 1 (1881) 219, 236 [9, 26], pl. 1, figs. 11–22.

Idiosepius pygmaeus BERRY, Rec. So. Austral. Mus. 1 (1921) 355, 357, 359, 361, text fig. 64, chart 11.

Dr. Theodor Mortensen, of the Copenhagen Museum, from an examination of the original material has kindly confirmed the type locality of this species as given in my earlier paper; namely, 4° 20′ north latitude, 107° 20′ east longitude.

IDIOSEPIUS PARADOXUS (Ortmann, 1888).

Micreteuthis paradoxa ORTMANN, Zool. Jahrb. Abth. Syst. 3 (1888) 649, 665, pl. 22, fig. 4.

Idiosepius pygmaeus SASAKI, Zool. Mag. Tokyo (1913) 401 (context in Japanese), pl., figs. 3, 4 (not of Steenstrup).

Idiosepius pygmaeus SASAKI, Annot. Zool. Jap. 8 (1914) 599.

Idiosepius pygmaeus SASAKI, Proc. U. S. Nat. Mus. 57 (1920) 191.

Idiosepius paradoxus BERRY, Rec. So. Austral. Mus. 1 (1921) 356, 357, 358, text fig. 65, chart 11.

Idiosepius pygmaeus SASAKI, Annot. Zool. Jap. 10 (1923) 209, text figs. 1–3 (behavior, etc.).

Idiosepius pygmaeus M. ISHIKAWA, Journ. Coll. Agr. Imp. Univ. Tokyo 7 (1924) (167), 179, pl. 10, fig. 33 (statocyst).

Additional distributional records.—JAPAN, surface Hakodate Bay (*Sasaki*); Onomichi, Bingo (*Sasaki*); Isé Province (*Sasaki*); Oki Island (*Sasaki*); Sado Island (*Sasaki*); Oshoro (*Sasaki*); Fuke, Mikawa (*M. Ishikawa*).

Remarks.—This species had been unknown to me from any direct observation with specimens until Professor Sasaki, after

my former paper, had the great kindness to send me a series, comprising two males and two females, collected by himself off Sagami Province, Japan, August 25, 1907 (S. S. B. 723), which entirely confirm my former impression of its distinctness from *pygmaeus*. As the specimens evidently are none of them fully grown (the largest has a mantle length of but 7 millimeters), I shall not dwell upon them at length here. There are a few points of some interest, however, that may be noted.

The larger of the two males shows seven suckers on the left nuptial arm and five on the right. The tentacles of these same specimens bear suckers for but little more than half their length and their unsuckered bases are scarcely as robust as most of the sessile arms, in these particulars showing a further deviation from Sasaki's figures, although not from his descriptions.

Sasaki, 1920 (p. 191), has carried the known range of this species in Japan as far to the north as Hakodate. He once wrote me (in litt. of August 10, 1920) that he had observed the curious habit for *Idiosepius* of adhering dorsally to seaweeds. Since then (1923) he has published a brief but highly important note on this strange behavior as manifested by specimens of *I. paradoxus* maintained under laboratory conditions. Other than this practically nothing is known of the natural history of any of these little squids, which now promises to be of as unique interest as their morphology.

No sexual dimorphism in size has been positively observed for this species so far as I can discover. My two males are, indeed, conspicuously smaller than the females, but this is possibly but an incident of this particular material that would disappear were all the specimens to attain equal maturity. Sasaki's Hakodate specimens have a recorded mantle length of 12 millimeters for the male and 15 millimeters for the female, but here again the specimens seen appear too few to afford certainty that the proportionate dimensions noted are characteristic for the sexes.

IDIOSEPIUS PICTETI (Joubin, 1894).

Loligo picteti JOUBIN, Rev. Suisse Zool. 2 (1894) 26, 60–64, pls. 3, 4.

Idiosepius picteti JOUBIN, Rev. Suisse Zool. 3 (1895) 459–460.

Naefidium picteti GRIMPE, Zool. Anz. 51 (1920) 205, 208–214, text figs. 1B, 2A–B.

Idiosepius picteti BERRY, Rec. So. Austral. Mus. 1 (1921) 356, 357, 359, 361, text fig. 66, chart 11.

Idiosepius picteti NAEF, Mitt. Zool. Stat. Neapel 22 (1921) 541 (brief note).

Remarks.—Grimpe, 1920 (p. 208-214), has gone to some length to separate this species not only from *Loligo*, its independence from which had already been fully recognized by Joubin and others, but from *Idiosepius* as well, regarding it as the representative of a new genus, *Naefidium*. In justification Grimpe advances two considerations; namely, the "long (loliginiform) mantle sack" and the peculiar hectocotylus, although in a postscript, in which he mentions the prior "Note complémentaire" of Joubin, he tacitly admits the essential similarity of the nuptial arm to that of *Idiosepius*, even while still maintaining that "die Validität des neuen Genus *Naefidium* dadurch nicht berührt wird." If his genus did not depend upon the characters of the nuptial arms it is hard, indeed, to discover a present foundation for it except such as may be gleaned from the peculiarities in body form. That the latter are as fundamental as alleged seems to me very doubtful when all known members of the group are brought into purview. Even the original figures given by Steenstrup for *I. pygmaeus* show sharp divergencies in their delineation of the posterior region of the body, the female being shown as obtusely pointed and only the male as smoothly rounded; that is, nearly sepioliform. That such apparent differences may not even be specific we are now aware through the investigation of the far more extreme sexual dimorphism manifested in the Australian *S. notoides*, which will be dwelt upon more at length in a forthcoming monograph on the South Australian cephalopod fauna. One needs concede but little leeway to the reconstruction of the older artists to bring the contours of the female *notoides* close to those of *picteti*, and the contours of male *notoides* to those of *pygmaeus*, the sex differences being fully as great in many particulars as the specific.

It follows that in order to recognize *Naefidium* as valid there must be established some character of import additional to a mere difference of bodily proportions to afford sufficient grounds for the generic separation, and this has not yet been done. While it should be remembered that each of the four described species of *Idiosepius* is so remarkably distinct from any of the others that an eventual dismemberment of the group may, indeed, be the outcome, new discoveries may so alter the whole situation that it is to be doubted whether any true progress is to be attained by striving at an uncertain and premature subdivision now.

DOUBTFUL SPECIES

The following elusory species from the earlier literature have been unsolved enigmas to all later students. They are not all referable to *Idiosepius* with any certainty, and were, therefore, omitted from consideration in my 1921 paper, but for the sake of historical completeness some mention of them in this connection should be made.

IDIOSEPIUS MINIMUS (Férussac, 1830).

Cranchia minima FÉRUSSAC, in d'Orbigny and Férussac, Céph. acét., Cranchies (1830) pl. 1, figs. 4–5 (teste d'Orbigny).

Loligo minima D'ORBIGNY and FÉRUSSAC, Céph. acét., Cranchies (1839) 319.

Loligo minima D'ORBIGNY, Moll. viv. et foss. (1845) 241, 351.

Loligo minima GRAY, Ceph. Brit. Mus. (1849) 75.

Loligo minima TRYON, Man. Conch. (I) 1 (1879) 150, pl. 58, fig. 192 (after d'Orbigny and Férussac).

Cranchia minima STEENSTRUP, K. d. Vid. Selsk. Skr. (6) 1 (1881) 224 [14].

Cranchia minima HOYLE, Rep. Chall. Ceph. (1886) 20, footnote (brief note).

Idiosepius minima [err. typ.] NAÉF, Mitt. Zool. Sta. Neapel, Bd. 22 (1921) 541 (merely listed).

Habitat.—Coast of Africa (*d'Orbigny*).

Remarks.—This hitherto apocryphal species has within recent years been referred by Naef to *Idiosepius*. The original figure and description have never been accessible to me, but a fragmentary copy of Tryon's monograph now in hand fortunately contains the pages dealing with *Loligo minima* and the plate containing the reproduction of Férussac's figure. Reference to these convinces me that Naef is reasonably near a correct generic allocation of the species. Indeed, Steenstrup himself (1881, p. 224) was inclined to a similar view, but the actual species represented is, and perhaps ever must remain, doubtful.

The mantle length is given as 15 millimeters, which is about the recorded maximum of *I. pygmaeus*, but the arms and tentacles are represented as considerably longer than in any of the established species of the genus.

LOLIGOPSIS PERONII Lamarck, 1812.

Loligopsis peronii LAMARCK, Extrait de son Cours de Zool. (1812) 123 (teste d'Orbigny).

Sepia sepiola PERON MS. in Lesueur, Journ. Acad. Nat. Sci. Phila. (1) 2 (1821) 100 (*not* of Linnaeus).

Sepia minima LESUEUR, Journ. Acad. Nat. Sci. Phila. (1821) 100.

Loligo peronii BLAINVILLE, Journ. de Phys. 96 (1823) 124 (teste Hoyle).
Loligo peronii BLAINVILLE, Dict. Sci. Nat. 27 (1823) 136.
Loligopsis peronii D'ORBIGNY, in d'Orbigny and Férussac, Céph. acét. (1845) 323 (teste Hoyle).
Loligopsis peronii D'ORBIGNY, Moll. viv. et foss. (1845) 253, 254, 372.
Loligopsis? peronii GRAY, Ceph. Brit. Mus. (1849) 41.
Loligopsis peronii STEENSTRUP, Overs. K. d. Selsk. Forh. (1861) 85 [17].
Loligopsis peronii TRYON, Man. Conch. (1) 1 (1879) 164.
Loligopsis peronii VERRILL, Trans. Conn. Acad. 5 (1881) 301.
Loligopsis peronii VERRILL, Rep. U. S. Comm. Fish and Fisheries 1879 (1882) 335 [125].
Loligopsis peronii ROCHEBRUNE, Bull. Soc. Philamth. Paris (7) 8 (1884) 14 [8].
Loligopsis peronii HOYLE, Proc. Roy. Phys. Soc. Edinb. 8 (1885) 314, 333.
Loligopsis peronii HOYLE, Rep. Chall. Ceph. (1886) 20 footnote, 46.

Habitat.—"Coast of Endrach, in New Holland" (*Lesueur*).

Remarks.—There has been a good deal of controversy, perhaps never possible of definite settlement, as to what Lamarck's *peronii* and therewith the old genus *Loligopsis* itself really are. I do not know whether the original specimen is any longer extant. Certainly the information that has been printed regarding it, as though not scanty enough at best, is strangely lacking in mention of all data of any critical import. Yet there are statements in some places and allusions in others that cause me to wonder whether some animal of our modern group *Idiosepius* was not actually what Lesueur and Lamarck had in hand. In connection with such an hypothesis the following considerations seem conceivably significant, although of course the mere fact that they do not conflict with the suggested interpretation in no wise proves its correctness:

1. The body is stated by d'Orbigny, 1845 (p. 373), to be fleshy (*carnosum*), rather than "gelatinous translucent" as stated by Hoyle, 1885 (p. 315), on the perhaps not too reliable authority of Blainville.

2. The fins are described as semirhomboidal and not rounded.

3. Lesueur, 1821 (p. 100), says that his *minima*, from "the coast of Endrach, in New Holland", differs from *sepiola* Linn., although from the very circumstance of Peron's name it was evidently considered sepioloid in form. He adds that it is "very small."

4. The mantle is described as "subacute at the base and finned inferiorly."

5. Coming from Australian waters the specimen falls within the probable range of *Idiosepius*.

Weighing contra are the following points:

1. The apparently deciduous tentacles (not readily lost by animals of the genus *Idiosepius*).

2. The alleged oceanic habit (Verrill, 1882, p. 335).

3. The fact that Blainville described the consistency of the body as gelatinous.

4. It is probably not certain that all the authors cited had the same animal in mind.

It is of interest to note that here again some such possibility as that suggested appears to have been considered by the indefatigable Steenstrup, even though if possible of proof his own genus *Idiosepius* would thereby be invalidated.

As matters stand the question remains about as far from satisfactory settlement as ever.

LOLIGOPSIS CHRYSOPHTALMOS (Tilesius).

Sepia chrysophtalmos TILESIUS, Krusenstern Voy. Atlas, pl. 38, figs. 32, 33 (teste d'Orbigny).

Loligopsis tilesii FÉRUSSAC, In d'Orbigny and Férussac, Céph. acét., Calmars (1825) pl. 1, figs. 2–4 (teste d'Orbigny).

Loligopsis chrysophtalmos D'ORBIGNY, Moll. viv. et foss. (1845) 304, 373, 374.

Loligopsis chromorpha D'ORBIGNY, Moll. viv. et foss. (1849) 373.

Loligopsis chromophora D'ORBIGNY, Moll. viv. et foss. (1845) 374.

Loligopsis ?chrysophtalmos GRAY, Ceph. Brit. Mus. (1849) 42.

Sepia chrysophthalmos STEENSTRUP, Overs. K. d. vid. Selsk. Forh. (1861) 86 [18] (brief note).

Loligopsis chrysopthalmos TRYON, Man. Conch. (1) 1 (1879) 164, pl. 69, fig. 256 (after d'Orbigny and Férussac).

Loligopsis chrysophthalma VERRILL, Trans. Coon. Acad. 5 (1881) 301.

Loligopsis chrysophthalma VERRILL, Rep. U. S. Comm. Fish and Fisheries, 1879 (1882) 335 [125].

Loligopsis chrysophtalmos ROCHEBRUNE, Bull. Soc. Philomath. Paris (7) 8 (1884) 14, 15 [8, 9].

Loligopsis chrysophtalmos HOYLE, Proc. Roy. Phys. Soc. Edib. 8 (1885) 330, 333.

Sepia chrysophthalmos APPELLOF, Bergens Mus. Aarsb. 1890 (1891) 25 (brief note).

Habitat.—Japan (*Tilesius*).

Remarks.—Steenstrup, 1861, considered that the crude illustrations published indicated that this very doubtful species had affinities with *Rossia* or some related genus. This was subsequently doubted by Appellof, 1891, on the ground that we have no justifiable reason to go back of the characters shown in Ti-

lesius's figures. I have seen only the figure in Tryon's Manual, which shows but seven arms as against the eight called for in the description and gives the observer little confidence that it is less faulty in other particulars. There is evident danger in too meticulously following so patently inaccurate a sketch. Granting a little necessary leeway in this direction, it does not require great imaginative powers to suggest the possibility that an *Idiosepius*, perhaps indeed even Ortmann's *paradoxus*, was really the animal intended to be described. Certainly the figure, such as it is, bears resemblance to an *Idiosepius* done in caricature, and the following additional points further favor the hypothesis:

1. The minute size—hardly an inch long ("a peine longue d'un pouce," according to d'Orbigny).
2. The subterminal separate fins.
3. The obvious sepioliform aspect.
4. The Japanese origin of the specimens, where
5. the species is said *to live on the fucus* (d'Orbigny, 1845, p. 373).

In the light of the recent remarkable observations of Sasaki (1923) that *I. paradoxus* has the peculiar habit of adhering to seaweeds, it seems to me that this last point, long overlooked as insignificant, at once becomes both suggestive and important, though doubtless still short of the virtual proof we should require before rejecting Ortmann's well-known name for the obscure if ancient one of Tilesius.

ERRATA

Owing to certain contingencies of publication of my 1921 paper no opportunity was afforded for proof reading by the author, and the paper consequently contains a number of typographical errors, some of the more troublesome of which, other than a number of misspellings in citation, are as follows:

Page 351, line 15, *for* with figs. *read* and ff. *or* et seq.
Page 352, line 3, for *kochil* read *kochii*.
Page 355, line 28, *for* with figs. *read* and ff. *or* et seq.
Page 356, line 31, *for* text fig. 2 *read* chart 11.
Page 358, line 27, for *kochii* read *pygmaeus*.
Page 360, line 6, for *paradoxa* read *paradoxus*.

ADDITIONAL BIBLIOGRAPHY [3]

APPELLÖF, A. Teuthologische Beitrage. II. Chaunoteuthis n. g. Oegopdidarum. Bergens Museums Aarsboretning 1890, 1 (1891) 1–29, pls. 1–4.

BERRY, S. S. A review of the cephalopod genera Sepioloidea, Sepiadarium, and Idiosepius. Rec. So. Austral. Mus. 1 (January, 1921) 347–364, text figs. 64–67, charts 10–11.

BLAINVILLE, M. H. DE. Mémoire sur les espèces du genre Loligo Lam. Journ. Phys. Paris 96 (1823) 116–133. Loligo. Art. in Dictionnaire des Sciences Naturelles 27 (1823) 126–148.

GRIMPE, G. Teuthologische Mitteilungen. Zool. Anz. 51 (August, 1920) 205–214, text figs. 1A–2B.

HOYLE, W. E. On Loligopsis and some other genera. Proc. Roy. Physical Soc. Edinburgh 8 (1885) 313–333.

ISHIKAWA, M. On the phylogenetic position of the cephalopod genera of Japan based on the structure of statocysts. Journ. Coll. Agr. Imp. Univ. Tokyo 7 (December, 1924) 165–210, pls. 8–13.

LESUEUR, C. A. Descriptions of several new species of cuttle-fish. Journ. Acad. Nat. Sci. Philadelphia 2 (1821) 86–101, pls. 6–12.

NAEF, A. J. Das system der dibranchiaten Cephalopoden und die mediterranen Arten derselben. Mitt. Zool. Sta. Neapel 22 (1921) 527–542, text fig. 1a–f.

D'ORBIGNY, A., and A. DE FÉRUSSAC. Histoire naturelle générale et particulière des céphalopodes acétabulifères, vivants et fossiles. Paris (1825–1845).

ROCHEBRUNE, A. T. d. Étude monographique de la famille des Loligopsidae. Bull. Soc. Philomath. Paris (7), 8 (1884) 7–28 [1–22], pls. 1–2.

SASAKI, M. Report of cephalopods collected during 1906 by the United States Bureau of Fisheries Steamer "Albatross" in the northwestern Pacific. Proc. U. S. Nat. Mus. 57 (1920) 163–203, pls. 23–26.

SASAKI, M. On an adhering habit of a pygmy cuttlefish, idiosepius pygmaeus Steenstrup. Annot. Zool. Jap. 10 (July, 1923) 209–213, text figs. 1–3.

STEENSTRUP, J. J. Overblik over de i Kjöbenhavns Museer opbevarede Blaeksprutter fra det aabne Have (1860–61). Oversigt over det Kongelige danske Videnskabernes Selskabs Forhandlinger (1861) 69–86 [1–18].

VERRILL, A. E. Report on the cephalopods of the northeastern coast of America. U. S. Comm. Fish and Fisheries, Rep. Commissioner 1879 (1882) 211–455 [1–245], pls. 1–46.

[3] Titles already cited in full in 1921 are not reprinted on this occasion, the present list of references being merely additional thereto.

ILLUSTRATIONS

PLATE 1

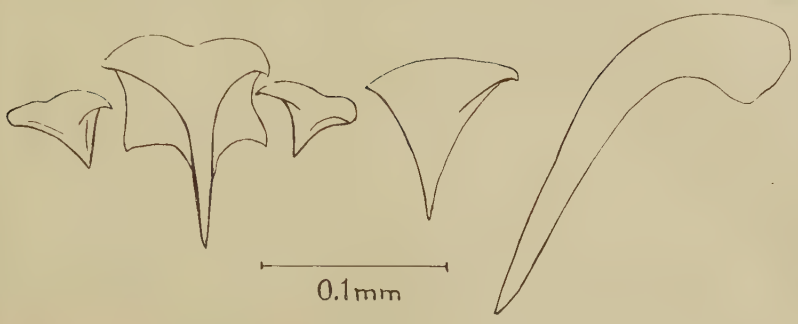
FIG. 1. *Sepiadarium kochii* Steenstrup, female [269]. Radula of specimen from Hongkong; part camera drawing from mount in balsam; teeth shown from same general region of radula, but not all from exactly the same transverse series.

2. *Sepiadarium nipponianum* sp. nov. male [724]. Left ventral arm of type in oral aspect; × 9. On account of the abrasion of most of the suckers from the original specimen, these have been uniformly supplied in the drawing except the distalmost pair. Rodman K. Cross del.

3. *Sepiadarium nipponianum* sp. nov., male [724]. Detail of left ventral arm in oral aspect; × 21; the suckers treated as in fig. 2. Rodman K. Cross del.

4. *Sepiadarium nipponianum* sp. nov., female [725]. Sucker of left tentacle club of paratype; camera sketch from mount in balsam.

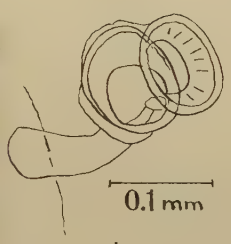
5. *Sepiadarium nipponianum* sp. nov., female [725]. Radula of paratype; camera sketch from mount in balsam.



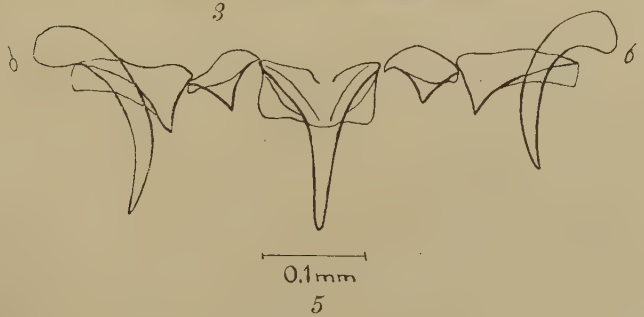
1

2

3



4



5

PLATE 1.

PHILIPPINE ERICACEÆ, III: A TAXONOMIC REVISION

CONCLUDED

By HERBERT F. COPELAND

Of Sacramento Junior College, Sacramento, California

EIGHT PLATES

Genus GAULTHERIA Linnæus

The type of *Gaultheria* is *G. procumbens* Linn., a plant of eastern Canada and the northeastern United States. About one hundred thirty species are recognized; of these about two-thirds belong to the American continents, North and South; about half a dozen are described from New Zealand and Tasmania; one from Australia; and about twenty from the continent of Asia. Fourteen species are at present recognized as inhabiting the Malay region; these may be arranged in three series, distinguished as follows:

1. Leaves generally under 2 cm long..... Allies of *G. nummularioides.*
1. Leaves generally over 2 cm long.
   2. Leaves elliptic, conspicuously punctate beneath. Allies of *G. fragrantissima.*
   2. Leaves ovate or lanceolate, usually acuminate, not conspicuously punctate beneath ..... Allies of *G. leucocarpa.*

ALLIES OF GAULTHERIA NUMMULARIOIDES

Gaultheria nummularioides D. Don was described in 1824 as occurring in India. *Gaultheria repens* Blume (1826), described from the Gedé, Java, is generally regarded as a synonym of *G. nummularioides.* The latter has been reported from Sumatra, as collected by Forbes and Robinson and Kloss, but not from the Malay Peninsula, nor from Borneo, Celebes, and eastward. If, as seems probable from the distribution, the Malayan form can be separated from the Indian, Blume's name is to be restored; it antedates by two years *Gaultheria repens* Rafinesque, a synonym of *G. procumbens.*

Gaultheria borneensis Stapf is known by two collections, both made on Mount Kinabalu at about 4,000 meters. In 1896, Rendle identified as *G. borneensis* a plant collected by Whitehead in northern Luzon. Merrill, on first collecting the same plant in

1905, regarded it as a new species and prepared a description; but presently concluded that Rendle had been correct, and left his description unpublished. In 1923, he reduced the Formosan *G. itoana* Hayata to *G. borneensis*. The Luzon plant is here described as a new species. I cannot at this time distinguish the Formosan from the Bornean species, but their geographical separation leads me to expect that this will be found possible.

Other species belonging to this group are the New Guinean *G. novaguineensis* J. J. Smith and *G. mundula* F. v. M.; the latter appears, from the original description, to be one of a very small number of species, definitely belonging to *Gaultheria*, but lacking the forked appendage on each anther cell. Non-Malayan species belonging to this group are *G. itoana*, already mentioned; *G. antipoda* Forst., which, with several varieties or related species, inhabits New Zealand, Tasmania, and Victoria; and the Indian *G. trichophylla* Royle.

The following is offered as a key to the Malayan species:

1. Anthers not four-horned at the summit; ovary glabrous..... *G. mundula.*
1. Each anther, as in most *Gaultheriae*, four-horned at the summit.
   2. Flowers always axillary, always with a definite pair of bracteoles immediately below the calyx; ovary glabrous.... *G. nummularioides.*
   2. Flowers usually in short terminal racemes, sometimes axillary toward the ends of the branches.
      3. Ovary glabrous.
         4. Bracteoles always paired and apical on the pedicel; horns on the anthers erect, about 0.5 mm long..... *G. novaguineensis.*
         4. Bracteoles usually distributed along the pedicel; horns on the anthers recurved, about 1 mm long..... *G. borneensis.*
      3. Ovary and branchlets pubescent; otherwise like *G. borneensis.* *G. benguetensis.*

1. GAULTHERIA BENGUETENSIS sp. nov. Plate 1, figs. 4 and 5.

Gaultheria borneensis RENDLE in Journ. of Bot. 34 (1896) 355; MERRILL in Philip. Journ. Sci. 3 (1908) Bot. 378, Enum. Philip. Fl. Pl. 3 (1923) 246.

Fruticulus humilis; rhizoma gracile ramosum; virgae erectae interdum ramosae, usque ad 20 cm altae, saepius breviores; caules graciles in juventate hirtelli; folia alterna, breviter petiolata, 1–2 cm longa, 3–5 mm lata, anguste elliptica vel oblanceolata, basi cuneata, apice obtusa vel acuta, margine serrata, dentibus in utroque margine c. 3–9, dente quoque glandulam solitariam capitatam ferente, supra glabra, subtus parce capitato-glandulosa, venis pinnatis adscendentibus manifestis paucis; flores terminales, interdum solitarii in pedunculis hirtellis c. 1 cm longis bracteas plures lanceolatas acuminatas ciliatas

ferentibus, interdum 2–4 in racemo, pedicellis ex axillis bracteārum proximalium pedunculi c. 5 mm longis, hirtellis, apice glandulas capitatas plures, submedie bracteas 2-3, ferentibus; calyx glaber, obconicus, 2.5 mm longus, lobis 5 triangularibus obtusis c. 1.5 mm longis apice minutissime ciliatis; corolla urceolata, c. 5 mm longa, alba vel rosea, lobis 5 minutis recurvis; stamina 10, filamentis c. 2 mm longis, applanatis, minutissime verrucosis, basi dilatatis; antheris c. 1.5 mm longis, parte distale cuiusque in tubulos duos divisa, tubulo quoque cornua duo c. 0.8 mm longa ferente; discus nullus vel obscurus; ovarium pubescens 1.5 mm altum; stylus teres glaber 3 mm longus; calyx fructiferus carnosus c. 5 mm latus, albus, capsulam loculicidam includens; semina numerosa fusca c. 0.5 mm longa, minutissime fovosa.

LUZON, Mountain Province, Benguet Subprovince, *Loher 3755* (*M*); Pauai to Baguio, *Merrill 4796* (M, W, type); Pauai, *Bur. Sci. 4283 Mearns* (M), *Bur. Sci. 4286 Mearns* (M, W), *For. Bur. 14438 Darling* (M), *Bur. Sci. 8421 McGregor* (M, W), *Merrill 710* (M, W), *Clemens 9206* (M), *Clemens s. n.* (M), *Bur. Sci. 31839 Santos* (M, W, C); Mount Pulog, *Bur. Sci. 44977 Ramos and Edaño* (M, C): Lepanto Subprovince, *Bur. Sci. 5955 Ramos* (M); Mount Data, *Clemens 16393* (C), *Clemens 18778* (C).

Known from a narrowly limited region in the central part of the Mountain Province, at altitudes from about 1,800 to 3,000 meters. Differs from *G. borneensis* and *G. itoana* by the pubescent branchlets and ovary.

ALLIES OF GAULTHERIA FRAGRANTISSIMA

A second species described by Blume, G. *punctata*, has been reduced to *G. fragrantissima* Wallich, but was distinguished as a variety of the same species by J. J. Smith. *Gaultheria fragrantissima* was described from India, and has been reported from the Malay Peninsula and from Sumatra, with a variety *papuana* J. J. Smith in New Guinea. Neither *G. fragrantissima* nor any close relative is known from the Philippines. I do not know the relationships of this species; it is at least not a member of the natural group discussed under the following heading.

ALLIES OF GAULTHERIA LEUCOCARPA

Gaultheria leucocarpa Blume was first collected in Java "in sylvis alterioribus." It has been reported from Sumatra and from the Malay Peninsula, with a variety *papuana* Beccari in

New Guinea, and Merrill has identified a specimen from French Indo-China as belonging here; these records from outside of Java are probably in error. *Gaultheria cumingiana* Vidal, from Luzon, is a closely related species. Other species which have been distinguished in this group are *G. crenulata* Kurz; *G. intermedia, G. celebica,* and *G. pullei,* all by J. J. Smith; *G. calyculata* Wernham; and *G. hirta* Ridley. One more species is described below; this is the only segregate from *G. cumingiana* or *G. leucocarpa* that I can base on Philippine material. I am convinced that other species will have to be segregated on the basis of extra-Philippine material; but this is not the place, nor have I material, for satisfactory descriptions. The following is a tentative classification of the group:

1. Corolla glabrous.
  2. Ovary pubescent.
    3. Horns on the anther tubes less than 0.1 mm long; leaves to 12 cm long; rhachides and the very short pedicels pubescent: A race in French Indo-China, represented by *Petelot 8.116.*
    3. Horns on the anther tubes about 0.3 mm long.
      4. Sepals more than half as long as the corolla, spreading: *G. pullei* and *G. calyculata.* These New Guinean species are perhaps not distinct, and may include *G. leucocarpa* variety *papuana* Beccari.
      4. Sepals less than half as long as the corolla, appressed.
        5. Leaves about 6 to 9 cm long, on well-developed petioles.
          6. Flowers in simple racemes; sepals glabrous within; fruit white: *G. leucocarpa,* probably confined to Java.
          6. Racemes sometimes branched; sepals pubescent within: *G. intermedia,* described from three specimens collected by Junghuhn, probably all from the same plant, locality (Java or Sumatra) uncertain.
        5. Leaves about 4 cm long, subsessile: *G. celebica,* known by a single collection.
    3. Horns on the anthers about 0.5 mm long; fruit black.
      4. Racemes generally over 5 cm long, with 8 to 10 or more flowers, rhachises sometimes pubescent: *G. crenulata* Kurz,[1] in Yunnan, Kwangtung, Sumatra, and probably the Malay Peninsula.
      4. Racemes glabrous, mostly under 5 cm long, with 3 to 6 flowers: *G. cumingiana,* in Luzon only.
  2. Ovary glabrous.
    3. Margins of the filaments glabrous: A race in Formosa.
    3. Margins of the filaments bearing a few hairs: A race in the southern Philippine Islands, *G. psilocarpa.*
1. Corolla pubescent: *G. hirta,* in Perak.

[1] *G. leucocarpa* Auct., non Bl; *G. cumingiana* Merrill in Lingnaam Agr. Rev. 4 (1927) 132, non Vidal.

2. GAULTHERIA CUMINGIANA Vidal. Plate 1, fig. 2.

Gaultheria cumingiana VIDAL, Phan. Cuming. Philip. (1885) 184, Rev. Pl. Vasc. Filip. (1886) 170; MERRILL in Philip. Journ. Sci. 3 (1908) Bot. 378, Enum. Philip. Fl. Pl. 3 (1923) 246.

The original description, in Vidal's Phanerogamae Cumingianae Philippinarum, reads:

Fructiculus ramis teretibus interdum sinuosis, glabris vel piloso-setosis. Petioli sub-nulli incrassati. Folia e basi rotundata vel sub-cordata, ovata vel lanceolato-ovata, longe obtuso-acuminata, apice saepissime calloso, longa 2–5 cm. lata 1–2 cm., prope basim lata, inaequaliter spinuloso-serrata vel calloso-serrata, glabra vel praesertim subtus ad nervos adsperse setosa, saepissime ciliata. Alabastra globosa. Flores parvi, 3–5 mm., in racemis axillaribus; bracteae ciliatae, bracteolae ad apicem pedicellorum. Calycis segmenta ovata, triangulares, mucronata, ciliolata. Corolla ovato-campanulata, lobis rotundatis saepissime reflexis. Antherarum loculi apice biaristati. Capsula globosa, 4–7 mm, diam.; calyce succulento, nigro-caeruleo inclusa. Semina numerosa, angulato-cuneata, texta nitida, rufescente.

Cum. 932 Prov. Albay.—Herb. prop. 818 Volcan Mayon, Prov. Albay; 1829 Distr. Lepanto.

LUZON, Albay Province, Mount Mayon, *Bur. Sci. 2923 Mearns* (M), *Bur. Sci. 6500 Robinson* (M): Laguna Province, Mount Banahao, *Loher 6200* (W), *For. Bur. 7896 Curran and Merritt* (M), *For. Bur. 8009 Curran and Merritt* (M), *Bur. Sci. 9846 Robinson* (M); Mount San Cristobal, *Gates 6375* (M): Zambales Province, Mount Pinatubo, *Clemens 17472* (C): Mountain Province, Benguet Subprovince, *Loher 3783* (W); Mount Santo Tomas, *Elmer 6253* (M, W), *Williams 951* (M, W), *For. Bur. 4958 Curran* (M), *For. Bur. 14170 Merritt* (M, W), *Sandkuhl 330* (M), *Merrill 11735* (M, W, C), *McClure 16050* (C); Baguio, *Elmer 8589* (W), *Sevrens 21* (M); Baguio to Ambuklao, *Merrill 4376* (M, W); Pauai, *Bur. Sci. 4277 Mearns* (M), *For. Bur. 14444 Darling* (M), *Bur. Sci. 8417 McGregor* (M), *Clemens 9190* (M), *Clemens s. n.* (M), *Bur. Sci 31785 Santos* (M, C); Pauai to Mount Data, *Clemens 16392* (C); Bugias, *Merrill 4672* (M, W); Batan, *Bur. Sci. 5891 Ramos* (M); Bucao, *For. Bur. 14424 Darling* (M): Lepanto Subprovince, trail to Balbalasan, *For. Bur. 5698 Klemme* (M): Bontoc Subprovince, *Vanoverbergh 748* (M): Ifugao Subprovince, Mount Polis, *Bur. Sci. 37619 Ramos and Edaño* (M).

At altitudes from about 1,500 (Baguio) to about 2,500 meters (Mount Santo Tomas; Pauai).

A rather variable plant; in height from less than 30 cm to more than 2 m; prostrate, erect or scandent. The stems of

some plants bear a fine pubescence mixed with large bristles, while those of others are strictly glabrous; pubescence and bristliness appear to be juvenile characters. The leaves are about 2 to 7 cm long, ovate or lanceolate, acuminate, sharply serrate, the teeth about 1 to 3 mm apart. The glabrous rhachises, 1 to 5 cm long, bear rather few (3 to 6) flowers on glabrous pedicels 2 to 9 mm long. Each pedicel is subtended by a minute ciliate bract and bears a pair of minute ciliate bracteoles, like those of a *Diplycosia,* below the calyx. The calyx is glabrous, cup-shaped, divided to below the middle into five acuminate ciliate lobes. The corolla is campanulate, 3 to 6 mm long, with 5 blunt recurved lobes about 1.5 mm long. The filaments are about 2 mm long (below the anther), flat, distinctly lanceolate, warty but not pubescent, merging into the backs of the anthers. The anthers are about 4 mm long; each anther cell is narrowed above into a forked tube about 1.5 mm long, and opens by a slit down the introrse face of the tube. The whole stamen reaches to about the base of the corolla lobes. The densely pubescent ovary is surrounded at the base by a lobed disk about 0.3 mm high. The terete glabrous style is 2 to 4 mm long. The fleshy fruiting calyx is always black (or blue- or purple-black). The fruit proper dehisces loculicidally, the distal portion splitting into five acute valves that may project slightly from the calyx. The very numerous subtetrahedral seeds are brown, with a surface describable as pitted, or conversely as reticulately ridged.

3. GAULTHERIA PSILOCARPA sp. nov. Plate 1, fig. 3.

Gaultheria cumingiana MERRILL in Philip. Journ. Sci. 2 (1907) 292; ELMER in Leafl. Philip. Bot. 3 (1911) 1091; non Vidal.

Species G. cumingianae et G. leucocarpae affinis, ovario glabro, filamentis capillos paucos ferentibus, distincta; calyx fructiferus niger.

Fruticulus terrestris (an semper ?), erectus, procumbens, vel subscandens; caulis saepius sinuosus, glaber vel in juventate hirtellus setosusque; folia alterna in petiolis teretibus 3–8 mm longis, laminis glabris, ovatis vel lanceolatis, 2–9 cm longis, 1–5 cm latis, basi rotundatis, apice acuminatis, margine inaequaliter serrulatis, dentibus glanduloso-vel setoso-apiculatis, inter se in foliis maioribus c. 3 mm distantibus, venatione manifesto; flores in racemis axillaribus, rhachidibus 2–6 cm longis, glabris, flores 2–9 ferentibus; pedicellis glabris 3–9 mm longis, apice bibracteolatis, bracteolis c. 1.5 mm longis, ovatis, acuminatis, glabris

marginibus ciliatis exceptis; calyx c. 2 mm altus, glaber, lobis 5 acuminatis ciliatis; corolla alba campanulata glabra, c. 4 mm longa, lobis 5, c. 1.5 mm longis, obtusis; stamina 10, filamentis applanatis lanceolatis c. 1 mm longis, margine papillosis, capillos paucos albos vix 0.5 mm longos ferentibus, anthers c. 2 mm longis, apice in tubulos duos attenuatis, tubulo quoque in cornua duo c. 0.5 mm longa diviso, per rimam introrsam dehiscente; ovarium globosum glabrum c. 1.5 mm longum; stylus teres glaber c. 2 mm longus; calyx fructiferus carnosus, niger, c. 6 mm latus, capsulam loculicidam includens; semina fusca subtetranedra foveolata c. 0.5 mm longa.

MINDORO, Mount Halcon, *Merrill 5725* (M, W). NEGROS, Canlaon Volcano, *Merrill 235* (M, W). MINDANAO, Bukidnon Province, Mount Candoon, *Bur. Sci. 38903 Ramos and Edaño* (M; type): Davao Province, Mount Calelan, *Elmer 11678* (W).

At altitudes from 1,800 (Mount Candoon) to 2,800 meters (Mount Calelan).

This species varies as *G. cumingiana* does, in stature, leaf size, and pubescence; it usually has larger leaves than *G. cumingiana,* and is readily distinguished, even in fruit, by the glabrous ovary. Flowers are known only by the collection from Mount Candoon, which is designated as the type; the constancy of the scattered hairs on the margins of the filaments is accordingly uncertain.

Genus DIPLYCOSIA Blume

Blume,[2] in describing his genus *Diplycosia,* assigned to it three Javan species. No more were known to G. Don,[3] who misspelled the name as *Diplecosia,* or to de Candolle.[4] The generic status of the poorly known group was long in doubt. Endlicher [5] included the group (without naming the species) under *Gaultheria,* as a subgeneric group called *?Amphicalyx,* a name which Blume [6] had proposed to substitute for his earlier one. The new combinations were made by Hasskarl,[7] who was followed by Zollinger [8] and by Miquel [9]; and Gray [10] described the first *Di-*

[2] Bijdr. (1826) 857.
[3] Gen. Syst. 3 (1834) 838.
[4] Prodr. 7 (1839) 591.
[5] Gen. Pl. (1836–1841) 756.
[6] Flora Javae (1828) introd. 7.
[7] Cat. Pl. Bog. (1844) 160. The names are ascribed to Endlicher.
[8] Syst. Verz. (1854–1855) 135. I have not seen this work, to which Miquel refers.
[9] Ann. Mus. Bot. Lugd. Bat. 1 (1863) 40–41.
[10] Proc. Am. Acad. Sc. 5 (1861) 324.

plycosia known from the Philippines as a *Gaultheria*. The last student of the group who rejected *Diplycosia* as a genus was F. von Mueller,[11] who, in describing *Gaultheria mundula*, argued strongly that the two genera cannot be distinguished.

Other authors have maintained the genus without understanding it, and have transferred to it any gaultherioid species which seemed not to fit into other genera. Bentham and Hooker [12] took note of "Species 7, montium Malaccae Javae et Borneo incolae." The four species added to those of Blume were not named: they were apparently in part undescribed, and in part species named under other genera; some of them probably do not belong to *Diplycosia*. At any event, Clarke [13] transferred to *Diplycosia*, *Gaultheria discolor* Nutt., a species from Bhutan, and described a new *D. semiinfera* from the same region. These authors, and following them Drude [14] defined the genus vaguely and inaccurately. Schlechter—probably without due study, since his conception of the genus was correct—transferred *G. mundula* F. v. M.; and Nakai [15] transferred *G. adenothrix* Maximowicz, a Japanese species. The four species last named have the flowers in racemes, and are to be excluded.

The first satisfactory statement, aside from those drawn directly from Blume's original description, of the essential characters of the genus, seems to have been made by Schlechter,[16] who wrote, "Ich möchte als ihr nicht angehörig alle diejenigen Arten betrachten, die eine traubige Infloreszenz haben, ferner die, welche sich durch das Fehlen der sehr charakteristischen Brakteen unterhalb der Blüte auszeichnen." If to the long-known character that the tube or appendage on each anther sac is not forked, we add the characters emphasized by Schlechter (the axillary production of flowers solitary or in fascicles, never in racemes, and the presence of two connate bracteoles just below the calyx), as well as a character emphasized by Blume, that the fruit proper is a thin-walled capsule which is indehiscent or shatters irregularly, we fully define and distinguish from other *Arbutoideæ* a natural genus inhabiting the Malay Region, mostly at rather high altitudes, and not extending

[11] Trans. Roy Soc. Vict. n. Vict. n. s. 1:2 (1889) 21.
[12] Gen. Pl. 2:2 (1876) 583.
[13] In Hook. f. Fl. Brit. Ind. 3 (1882) 495.
[14] In Engler und Prantl. Nat. Pflanzenfam. 4:1 (1891) 46.
[15] Bot. Mag. Tokyo 35 (1921) 135.
[16] Englers Bot. Jahrb. 55 (1918) 162.

outside of that region. *Diplycosia pilosa,* which Blume listed first is to be accepted as the type.

The first large addition of valid species was made by Beccari,[17] who described seven species from the Arfak Mountains in Dutch New Guinea, from Amboina, and from Sarawak. Another was made by Stapf,[18] who described ten new species from Mount Kinabalu. Since 1894, the gradual progress of exploration in New Guinea, in the Malay Peninsula, and in the Philippines, has added many more. Altogether a total of fifty-two species have been assigned to the genus; but this number is to be decreased to about forty, by the exclusion of some, as mentioned above, and by the reduction of five in the present paper.

The subgeneric classification is difficult. Bentham and Hooker described two subgenera, distinguished by the habit; their classification is to be rejected, because *D. pilosa,* the type, was included in *Gaultheriopsis* instead of in *Eudiplycosia* and because the remaining species of the former subgenus were not enumerated, and were in all likelihood in part not *Diplycosiæ* at all. Natural classification involves the working out of lines of descent. The hypotheses are offered, that *Diplycosia* is descended from *Gaultheria;* that the original *Diplycosia* was a plant of India or of the Malay Peninsula (perhaps of Borneo, since that island, with but poor exploration, shows a great number of species); and that it was an erect plant, with bristly leaves of moderate size, the stem bristly, the flowers numerous in fascicles or perhaps in short racemes, the pedicels and calyces bristly, the anthers drawn out into long tubes opening by introrse slits, the pistil pubescent. The known species would be derived from such an ancestor by the loss of pubescence from different parts independently, by the shortening of the tubes on the anthers, and by changes in habit and in the size and shape of the leaves. Species very similar to one another may have arisen by different lines of descent, and it would require careful study to avoid an artificial classification. The species are not well enough known to warrant attempting such a classification; as for descriptions, Blume and Beccari describe almost nothing beyond the vegetative characters of the species; and as for specimens, these are in this genus very frequently unsatisfactory, since the small flowers and fruits become disjointed between the bracteoles and the calyx, and are lost.

[17] Malesia 1 (1877) 210–212.

[18] Trans. Linn. Soc. Bot. 4 (1894) 191–195.

Thirteen species have been described from the Philippines. Among these, *D. loheri* Merrill, described in 1925, and known by a single collection from the Caraballo Mountains, is well distinguished by the bristly calyx; while *D. trinervia* Elmer, to which *D. urdanetensis* Elmer is here reduced, and which is known by two collections from Mindanao, is distinguished by elongate anthers.

As for the remaining species, the flowers of all, so far as they are known, are essentially alike; the specific differences lie in the size, shape, and surface of the leaves, and in the number per cluster, length, and surface of the pedicels. It is possible that there may be a difference in the fruiting calyces, which appear in some specimens completely to inclose the capsules, and in others to subtend them; but I am not certain that this is more than a difference in stage of development.

There are only two localities from which collections have been made in such numbers that the extent of variation to be expected in a given race can be estimated. One of these, fortunately, is Mount Banahao, the type locality of *Diplycosia luzonica* Merrill. This was described by Gray, under *Gaultheria*, in 1861, from the collections of the United States Exploring Expedition under Captain Wilkes; it was the only Philippine *Diplycosia* described before the American occupation of the Islands. Gray's description was very brief. It is significant of the difficulty of working with *Diplycosia* that the flowers were not collected at the easily accessible type locality until 1918. The leaves are quite setose when young, but become denudate with age. Merrill, who happened at first to know the topotypic race only by a single denudate leaf from the type specimen, took the essentially glabrous race on Mount Santo Tomas as typical of *D. luzonica*, and described as species two races distinct from that, *D. scandens*, from the Mountain Province, in 1906, and *D. merrittii*, from Mount Halcon, in 1907. The variability shown by our present series of specimens from Mount Banahao leads to the reduction to *D. luzonica* of both *D. scandens* (which Merrill reduced in 1908, and restored in 1923) and *D. merrittii*, and also, less certainly, of *D. fasciculiflora*, a small-leaved plant from the Mountain Province, described in 1915.

The race on Mount Santo Tomas is also known by several collections. It appears to vary so as to overlap *D. calelanensis* Elmer, a species described in 1911 as occurring on Mount Apo, to which the Santo Tomas race is accordingly referred. It appears at the same time to overlap *D. glabra* Merrill, described

in 1919 as inhabiting the Mountain Province, and here reduced to *D. calelanensis.*

Beside the four species already mentioned, four more are here maintained, two described by Elmer, one by Merrill, and one by C. B. Robinson; these are maintained more by ignorance than by recognition of distinctive characters. None is known by more than one collection from any locality, nor from more than two localities; and of none have I seen mature flowers (those of *D. apoensis* and *D. baclayanensis* are known by Elmer's descriptions; those of *D. opaca* were described from buds; those of *D. parvifolia* are unknown).

Key to the Philippine species.

1. Calyx beset with large bristles..... 1. *D. loheri.*
1. Calyx glabrous or puberulent, not bristly.
2. Flowers three or more in the cluster, or if not, leaves over 3 cm long.
3. Anthers linear, about 3 mm long..... 2. *D. trinervia.*
3. Anthers oblong, not over 2 mm long.
4. Pedicels usually densely bristly; leaves bristly at least when young, 1 to 9.5 cm long..... 3. *D. luzonica.*
4. Pedicels sparsely or not at all bristly; leaves glabrous.
5. Leaves not thickly coriaceous.
6. Leaves 3 to 6 cm long, obtuse or acute..... 4. *D. calelanensis.*
6. Leaves 4 to 8.5 cm long, mostly rounded..... 5. *D. opaca.*
5. Leaves thickly coriaceous, 6 to 7 cm long.... 6. *D. baclayanensis.*
2. Flowers solitary or in pairs; leaves not over 3 cm long.
3. Leaves 3-nerved..... 7. *D. apoensis.*
3. Nerves, except the midrib, obsolete..... 8. *D. parvifolia.*

1. DIPLYCOSIA LOHERI Merrill. Plate 1, figs. 6 and 7.

Diplycosia loheri MERRILL in Philip. Journ. Sci. 27 (1925) 44, Enum. Philip. Fl. Pl. 4 (1925) 253.

The original description reads:

Frutex ut videtur scandens, ramulis et pedicellis et calycis perspicue patule ciliato-setosis; foliis elliptico-ovatis, subcoriaceis, obscurrisime nervosis, 2.5 ad 4 cm longis, acuminatis, basi obtusis ad subrotundatis, utrinque margineque parce setosociliatis; floribus axillaribus, solitariis vel binis, rariter trinis, tenuiter pedicellatis, pedicellis 1 ad 2.5 cm longis; corolla turbinata, glabra, 5.5 mm longa, lobis late ovatis, reflexis, 1.5 mm longis; filamentis glabris, 2 ad 2.5 mm longis, antheris circiter 1.4 mm longis, apice breviter productis.

A shrub, apparently scandent, the branchlets, pedicels, and calyces conspicuously ciliate-setose with numerous, reddish brown, spreading hairs 0.5 to 3 mm long, similar but more-scattered hairs on both surfaces of the leaves and on their margins. Branches glabrous, dark when dry, the branchlets paler, the ultimate ones 1 to 1.5 mm in diameter. Leaves subcoriaceous, elliptic-ovate, somewhat acuminate, base obtuse to rounded,

olivaceous on the upper surface when dry, paler beneath, 2.5 to 4 cm long, 1.5 to 2.5 cm wide, the nerves obscure, frequently only a subbasal pair, never more than two pairs, evanescent, reticulations obsolete; petioles ciliate-setose, 2 to 3 mm long. Flowers axillary, solitary or in pairs or threes, their slender, conspicuously ciliate-setose, slender pedicels 1 to 2.5 cm long. Calyces densely and conspicuously ciliate-setose, the tube about 3 mm long, the lobes triangular, acute, less than 1 mm long. Corolla glabrous, somewhat turbinate, 5.5 mm long, the lobes recurved, broadly ovate, obtuse, 1.5 mm long. Filaments glabrous, 1.5 to 2 mm long, the anthers about 1.4 mm long, their apices somewhat produced.

LUZON, Nueva Vizcaya Province, Caraballo Mountains, *Loher 13693*, March, 1915.

A remarkably distinct species, distinguished among all hitherto known Philippine forms by its conspicuously ciliate-setose calyces, the setæ being reddish brown, spreading, 0.5 to 2.5 mm in length, similar to those on the long slender pedicels, the branchlets, petioles, and leaves. The scattered setose hairs on the lower surface of the leaves spring from small dark-colored glands, these glands persisting after the setæ fall.

Known only by the type collection (M, C), which is, indeed, remarkably distinct. The pedicels bear, beside the reddish bristles, a dense pubescence of minute white simple hairs. The massed descending bristles on the calyx do not extend onto the lobes, which are glabrous except for the finely white-ciliate margins. The anthers are of the same structure as in *D. calelanensis* and *D. luzonica*, but are smaller. The pistil is glabrous; the ovary about 1.5 mm high, the style about 2 mm long.

2. DIPLYCOSIA TRINERVIA Elmer. Plate 2, figs. 1–2.

Diplycosia trinervia ELMER in Leafl. Philip. Bot. 3 (1911) 1102; MERRILL, Enum. Philip. Fl. Pl. 3 (1923) 247.

Diplycosia urdanetensis ELMER in Leafl. Philip. Bot. 7 (1915) 2628; MERRILL, Enum. Philip. Fl. Pl. 3 (1923) 247.

Frutex epiphyticus, ramulis juvenilibus plus minusve setosis. Folia alterna; petioli 3–7 mm longi, glabrescentes; laminae ellipticae, ad oblanceolatae, 3.5–7 cm longae, c. 2 cm latae, basi cuneatae, apice subacuminatae, apiculatae, supra glabrae, subtus punctatae, margine recurvae, serrulatae, in juventate setoso-ciliatae, trinerviae, reticulationibus obsoletis. Flores solitarii ad trini in fasciculis axillaribus; pedicelli gracili, parce setosi, 10–20 mm longi; bracteolae acutae c. 1 mm longae, in costulo margineque ciliatae et glanduloso-ciliatae; calyx obconicus, c. 4 mm latus, lobis 5 acutis, margine quasi bracteoli; corolla campanulata vel subcylindrica, viridicans, c. 5 mm longa, lobis 5 obtusis; stamina 10, filamentis glabris sigmoideis 2.5–3.5 mm longis, antheris lanceolatis 3 mm longis, dimidiis superioribus in tutulis connatis angustatis, per rimis introrsis apicalibus 0.5

mm longis dehiscentibus; ovarium subglobosum glabrum 2 mm latum; stylus glaber c. 5 mm longus.

The original description reads:

An epiphytic shrub; stems quite rigid, branched; wood tough, covered with gray bark; twigs especially the younger portion brown when dry and covered with similarly colored setose hairs. Leaves conspicuously scattered along the branchlets, alternate, rigidly coriaceous, oblong elliptic, similarly tapering toward both acute ends, the apex terminated into a very short mucronate point, glabrous on the upper sublucid surface, paler green beneath, brown in the dry state, entire, margins subinvolute and with occasional bristle-like brown hairs, beneath glandular punctate or with few hairs along the nerves or from the glands, the average blades 5 cm. long, 2.5 cm. wide across the middle, the smaller ones similar in shape; midrib conspicuous beneath, impressed above, usually with only 1 pair of lateral nerves subopposite ly arising from 3 to 5 mm. from the base and curvingly extending clear to the apex, occa ionally a minor pair arises from the base and runs along the margin, the upper oblique secondary nerves obscure or obsolete; petiole stout, 5 mm. long, brown, setose but ultimately glabrous. Flowers few clustered in the leafy axils, pendulous; pedicels slender, brown hairy; recurved, 1.25 cm. long or longer, subtended at the base by minute bracts; involucral disk 3 mm. wide across the rim, 1.5 mm. high, pectinately glandular along the margin, otherwise nearly glabrous; calyx greenish, 5 mm. long, tapering from base to the broad 5-dentate throat, similarly glandular along the edges, the teeth rather blunt; corolla glabrous, 7.5 mm. long, campanulate, the 5 short acute segments reflexed; stamens 10; filaments flattened toward the base, glabrous, 3.5 mm. long, inserted on the base of the corolla; anthers nearly as long, attached to the back below the middle, gradually tapering from the bilobed base to the sterile apical portion, minutely pulverulent, without appendages; ovary superior, flattish globose, glabrate, 2.5 mm. across; style also glabrous, 6 mm. long, columnar, bearing a terminal but not enlarged stigma; fruit not seen.

Type specimen 11676[a], *A. D. E. Elmer*, Todaya (Mt. Apo), District of Davao, Mindanao, September, 1909.

This *Diplycosia* was collected in the elfinwoods on the summit of Mount Calelan. See note under the preceding [i. e. under *D. apoensis*].

The original description of *D. urdanetensis* reads:

Epiphytic and shrubby; stems few from the same cluster, mostly descending. 1 m long or longer, rather sparingly branched; wood white, rigid and covered with a smooth dark brown bark, the younger portions of the twigs glabrous, old branchlets roughened by the large leaf scars. Leaves numerous, drying dull brown on both sides, glabrous, marginal portion curved upon the nether side, entire or subentire above the middle, horizontal or descending, obtuse at both ends or acute and mucronately pointed at the apex, oblong or occasionally obovate, the larger ones 7 cm long with the petiole, 2.5 cm wide across the middle, the smallest ones broadly oblanceolate, shining and nearly black in the dry state on the upper surface, dull brown beneath; midvein straight, prominent beneath, cani-

culate above; usually only one pair of lateral veins arising 8 mm from the base, ascending, curved and connivent into the apex; petiole at least 5 mm long, thick, glabrate, caniculate above, reddish brown on the dry specimens. Flowers in small axillary clusters; slender pedicel slightly recurved, whitish, 1.33 cm long, its distal end expanded into a saucer shaped disk 2.5 mm across and whose truncate edge is minutely ciliate; calyx 3.5 mm high, cup shaped, rigidly coriaceous, glabrate, the lower two thirds united, the apical portion terminated into 5 rather broad teeth whose apices are mostly acute, the outer marginal portion of the teeth puberulent; corolla greenish white, 4.5 mm long, the 5 segments contiguous in the bud state, ultimately free and oblong, glabrous, obtuse at the apex; stamens 10, included, becoming exposed by pushing off the corolla, inserted upon the basal inner portion of a glabrous irregularly lobed or pointed rim; filaments 2.5 mm long; also glabrous, compressed and widened toward the base; anthers erect, basifixed, nearly as long, auriculately lobed at the base, gradually tapering to the blunt apex, on the inner side apparently with a pair of linear sac-like extensions from above the middle to nearly the base; ovary subglobose, 2 mm in diameter, glabrous and almost black in the dry state, obscurely rugose; neck at least 3 mm long, straight, glabrous, terminated by a minute stigma.

Type specimen number 13800, *A. D. E. Elmer,* Cabadbaran (Mt. Urdaneta), Province of Agusan, Mindanao, September, 1912.

Discovered in the stunted moss laden summit woods of mount Urdaneta at 6,500 feet elevation. 'Minamol' in Manobo.

From *Diplycosia trinervia Elm.* it differs mainly in its glabrous or nearly glabrous not setose character; from *Diplycosia merrittii Merr.* in having thinner more elongated trinervous leaves; and from *Diplycosia calelanensis Elm.* by the slender or longer pedicels and distinctly pointed leaves.

MINDANAO, Davao Province, Mount Calelan, *Elmer 11676a* (W, type): Agusan Province, Mount Urdaneta, *Elmer 13800* (M, W, S, type of *D. urdanetensis*).

The cotype of *D. trinervia* is unsatisfactory, but seems to match the type material of *D. urdanetensis.* The difference in bristliness is real, but it is a matter of degree, not absolute. As to the differences in length of corolla and style that appear in the original descriptions, I cannot judge, since the type bears no mature flowers. It is, of course, only by description that I know the stamens of *D. trinervia.* They are apparently the same as the quite distinctive stamens seen in the type material of *D. urdanetensis:* and I conclude that the latter species, though very much better typified, is to be reduced. The anthers are about twice as long as, but no wider than, those of any other Philippine species. A comparison of the above descriptions with Smith's full description of *D. pilosa* strongly suggests that reduction be carried farther; not having seen material of *D. pilosa,* I refrain from reducing *D. trinervia* to that species. *Diplycosia celebensis* J. J. Smith, as well as several of the species from Mount

Kinabalu which were described by Stapf, appear, from the descriptions and figures, to have anthers of the same character.

3. DIPLYCOSIA LUZONICA (A. Gray) Merrill. Plate 2, figs. 3–6; Plate 3; Plate 4, fig. 1.

Diplycosia luzonica (A. Gray) Merrill in Philip. Journ. Sci. 2 (1907) Bot. 293, 3 (1908) Bot. 378, 5 (1910) Bot. 371, Enum. Philip. Fl. Pl. 3 (1923) 247.

Gaultheria luzonica A. Gray in Proc. Am. Acad. Sci. 5 (1861) 324.

Diplycosia fasciculiflora Merrill in Philip. Journ. Sci. 10 (1915) Bot. 52, Enum. Philip. Fl. Pl. 3 (1923) 246.

Diplycosia merrittii Merrill in Philip. Journ. Sci. 2 (1907) Bot. 293, 3 (1908) Bot. 378, Enum. Philip. Fl. Pl. 3 (1923) 246.

Diplycosia scandens Merrill in Philip. Journ. Sci. 1 (1906) Suppl. 219, Enum. Philip. Fl. Pl. 3 (1923) 247.

The original description reads:

GAULTHERIA (DIPLYCOSIA) LUZONICA (sp. nov.): foliis ovalibus utrinque acuminatis supra glabris subtus ramisque novellis parce strigoso-hispidis; pedunculis fasciculatis petiolo longioribus; bracteolis connatis orbiculatis. Luzon, in the Majaijai Mountains; in fruit.

This may be amended to read as follows:

Arbor, frutex, vel suffrutex, terrestris vel epiphyticus, ad 6 m altus, ramulis junioribus dense fulvo-setosis; folia alterna, petiolis in juventate setosis, 3–7 mm longis, laminis in juventate utrinque setosis 2–10 cm longis, 1–6 cm latis, figura mutabilissima, lanceolata, ovata, ovale, elliptica, obovata, vel oblanceolata, apiculatis, margine recurvis, prope apicem serrulatis, setoso-ciliatis, venatione mutabile interdum obsoleto, foliis minoribus saepius triplinerviis, majoribus subpenninerviis, flores trini ad octoni in fasciculis axillaribus, pedicellis setosis hirtellisque rare subglabris 3–15 mm longis; bracteolae connatae, ovatae, c 1.5 mm longae, glabrae vel hirtellae, margine ciliatae et glanduloso-ciliatae; calyx obconicus 3–5 mm latus, glaber ad dense hirtellus, lobis 5 margine quasi bracteolae; corolla subglobosa glabra vel parce hirtella, 3–4 mm longa, alba ad rosea, lobis 5 ovatis, recurvis, c. 1 mm longis, parce glanduloso-ciliatis vel integris; stamina 10, filamentis glabris 2–3 mm longis, antheris oblongis 1.5–2 mm longis, tubulis apicalibus 0.2–0.4 mm longis; discus obscurus lobatus c. 0.3 mm altus; ovarium glabrum subglobosum 1.5 mm latum; stylus glaber 2–3 mm longus; pedicelli fructiferi accreti, calyx globose accretus, c. 7 mm latus, carnosus, niger, fructum c. 4 mm latum includens; semina fulva applanata subtriangularia c. 1 mm longa.

The original description of *D. fasciculiflora* reads:

Species *D. parvifoliæ* affinis, differt floribus fasciculatis, pedicellis brevioribus, ramis ramulisque glabris, vix setosis.

Apparently scandent, probably epiphytic, the branches terete, glabrous, dark reddish-brown, the branchlets paler, glabrous, not at all setose. Leaves coriaceous, elliptic to elliptic-oblong, dull, 2 to 4 cm long, 1 to 1.5 cm wide, when young with few, long, slender, brown, setose hairs on the margins, and scattered ones on both surfaces, when mature quite glabrous, the midrib prominent, lateral nerves obsolete, base and apex acute; petioles 2 to 3 mm long, slightly setose. Flowers small, pedicelled, in axillary fascicles, up to 8 in each fascicle, the pedicels slender, glabrous, 5 mm long or less, the basal bracts small, the apical bracteoles very broadly ovate, obscurely acuminate, puberulent. Calyx glabrous, somewhat accrescent and 2.5 mm long, the lobes triangular, acute, about 1 mm long. Corolla and stamens not seen.

LUZON, Subprovince of Ifugao, Mount Polis, *Bur. Sci. 19758 McGregor*, February 1, 1913.

A species very similar and manifestly closely allied to *Diplycosia parvifolia* Merr., of Negros, strongly resembling that species in vegetative characters, especially in the obsolete lateral nerves and reticulations. It differs from that species, however, in its flowers being fascicled, not solitary, its longer pedicels, and somewhat larger leaves.

The original description of *D. merrittii* reads:

Frutex pseudoepiphyticus scandens, inflorescentiis excepti, glabra; foliis coriaceis oblongo vel elliptico-ovatis, rariter oblongo-lanceolatis, breviter acuminatis, 6 ad 10 cm. longis, basi acutis nervis utrinque 2 vel 3, subtus prominentibus; flores axillares, fasciculati; corolla ovoidea, 6 ad 7 mm. longa.

A scandent pseudoepiphytic shrub often 6 m. high, glabrous except the inflorescence. Branches gray or brown, terete, the younger ones angular. Leaves coriaceous, oblong-ovate to elliptical-ovate, rarely oblong-lanceolate, 6 to 10 cm. long, 2 to 5 cm. wide, the base acute, the apex slightly acuminate, the margins obscurely denticulate, recurved, paler and glandular punctate beneath; nerves 2 to 3 on each side of the midrib, ascending, impressed above, rather prominent, the reticulations nearly obsolete; petioles stout, 4 to 8 mm. long, rugose. Flowers pink, fascicled, 2 to 8 in each axil, the pedicels slender, slightly pubescent, 1 to 1.5 cm. long, the apical bracts two, orbicular-ovate, 1.3 mm. long. Calyx very slightly pubescent, 3.5 mm. long, the lobes ovate or narrowly ovate, acute, 2 mm. long. Corolla ovoid, narrowed below, 6 to 7 mm. long, the lobes 5, ovate, broadly acuminate, 2 mm. long, reflexed. Stamens 10, glabrous; filaments 3 mm. long; anthers oblong, 1.5 mm. long. Ovary glabrous, style 2 mm. long. Fruit ovoid or subglobose, soft, fleshy, 1 cm. in diameter, black when mature.

In ridge forests at 1,400 m. alt. (No. 5670) (type), very abundant, the fruit edible but nearly tasteless; also collected by *Merritt* in June, 1906, at an altitude of from 1,600 to 1,700 m. (Nos. 4413, 4415, 4437). The same form has been collected in Palawan, Victoria Peak (666 *Foxworthy*) March, 1906.

Of the Philippine species of this genus, apparently most closely related to DIPLYCOSIA LUZONICA (A. Gray) (*Gaultheria luzonica* A. Gray), from Mount Banajao and Mount Santo Tomas, Luzon. I have before me a single leaf from the type of *Gray's* species kindly supplied by Dr. *J. N.*

Rose of the U. S. National Museum. No. 5932 *Elmer* from Mount Santo Tomas seems to match it exactly. The species proposed above differs from this in its larger, differently shaped leaves, much longer pedicels and more prominently nerved leaves, the venation in the two species being quite different. I have seen no flowers of *Gaultheria luzonica.*

The original description of *D. scandens* reads:

A scandent more or less hispid pseudo-epiphytic shrub reaching a height of 4 m., with ovate or narrowly-ovate, short acuminate or acute leaves and fascicled flowers. Branches slender, gray or brown, the younger ones rather strongly beset with long brown appressed bristly hairs. Leaves coriaceous 3 to 4.5 cm. long, 1.5 to 2.5 cm. wide, the base rounded, entire, gradually narrowed above, glabrous on the upper surface or with very few hairs, beneath paler and with scattered bristly hairs; petioles about 3 mm. long, densely bristly hairy; nerves 2 on each side of the midrib, both below the middle of the leaf. Flowers axillary, 3 to 6 in each axil, the pedicels pubescent, about 4 mm. long, 2-bracteolate at the apex, the bracteoles 1 mm. long, broader than long, ciliate. Calyx teeth broad, ovate, obtuse, about 1 mm. long, ciliate. Corolla white, about 5 mm. long, 3.5 mm. in diameter, the lobes broadly ovate, acute, reflexed, nearly 2 mm. long. Stamens 10; filaments 2 mm. long, not dilated below, glabrous; anthers about 1.2 mm. long, not horned. Ovary superior, glabrous, globose, 5-celled, cells many-ovuled; style about 2.2 mm. long.

LUZON, District of Lepanto, Mount Data (4597 *Merrill*) November 4, 1905. Pseudoepiphytic on mossy tree trunks in ravines, mossy forest at about 2,250 m. The first species of the genus to be reported from the Philippines, unless *Gaultheria* (*Diplycosia*) *luzonica* A. Gray, Proc. Am. Acad. 5 (1862) 324, proves to be a true *Diplycosia.* Gray's description is so short that I have been unable to locate his species, the type being from the collections made by members of the Wilke's [!] U. S. Exploring Expedition from "Luzon, in the Majaijai Mountains" (Mount Banajao). Dr. B. L. Robinson informs me that the type is not in the Gray Herbarium. A second, apparently closely related but glabrous species, is represented by No. 5932 *Elmer,* Province of Benguet, Luzon, the specimens with fruit only.

LUZON, Laguna Province, Mount Banahao, *U. S. Expl. Exped. s. n.* (W; M, fragm. ex W; type), *Loher 6208* (M), *For. Bur. 7884 Curran and Merritt* (M, W), *For. Bur. 7892 Curran and Merritt* (M), *Bur. Sci. 6851 Robinson* (M), *Bur. Sci. 19585 Ramos* (M, W), *Foxworthy s. n.* (M), *Quisumbing s. n.* (M), *Quisumbing 1140* (M), *Quisumbing 1306* (M), *For. Bur. 30076 Sulit* (C): "Luzon Central," Bulacloco, *Loher 3771* (W): Mountain Province, Benguet Subprovince, *Clemens 17217* (C); Mount Simacoco, *Bur. Sci. 40327 Ramos and Edaño* (M); Mount Pulog, *For Bur. 18048 Curran, Merritt, and Zschokke* (M, W), *Bur. Sci. 44884 Ramos and Edaño* (M, C); Mount Pulogloco, *Bur. Sci. 40397 Ramos and Edaño* (M); Mount Baudan, *Bur. Sci. 40307 Ramos and Edaño* (M): Lepanto Subprovince, Mount

Data, *Merrill 4579* (M, W, type of *D. scandens*), *Clemens 13691* (C), *Clemens 17822* (C); Balbalasan, *For. Bur. 5693 Klemme* (M): Abra Subprovince, *For. Bur. 14613 Darling* (M): Bontoc Subprovince, Mount Pukis, *Bur. Sci. 37811 Ramos and Edaño* (M): Ifugao Subprovince, Mount Polis, *Bur. Sci. 19758 McGregor* (M; type of *D. fasciculiflora*). MINDORO, Mount Halcon, *For. Bur. 4413 Merritt* (M), *For. Bur. 4415 Merritt* (M), *For. Bur. 4437 Merritt* (M), *Merrill 5670* (M, W, type of *D. merrittii*). PALAWAN, Mount Victoria, *Bur. Sci. 666 Foxworthy* (M, W). NEGROS, Cuernos Mountains, *Elmer 10184* (M, W); Canlaon Volcano, *Merrill 236* (M, W). MINDANAO, Misamis Province, Mount Malindang, *For. Bur. 4776 Mearns and Hutchinson* (M): Bukidnon Province, Mount Lipa, *Bur. Sci. 38540 Ramos and Edaño* (M).

At elevations from 360 (Mount Malindang) to 3,000 meters (Mount Pulog); mostly at about 2,000 meters.

The specimens here cited are by no means perfectly uniform: thus the plants from the neighborhood of Mount Data (*D. scandens*) have rather small, ovate, and sharp-pointed leaves, and very short pedicels; the type material of *D. fasciculiflora* appears to be merely an individual variation with still smaller leaves; plants from the neighborhood of Mount Pulog have markedly fine-hairy calyces; and those from Mount Halcon (*D. merrittii*) have especially large leaves and long pedicels. I have not seen topotypic material of *D. merrittii* in young stages; it is possible that the young leaves are not setose, in which case the species might possibly be retained. However, the whole series of specimens gives an appearance of specific identity; and I believe that if all the material from Mount Banahao now present and available had been collected and identified soon enough, neither *D. scandens* nor *D. merrittii* would have been described.

4. DIPLYCOSIA CALELANENSIS Elmer. Plate 5, fig. 1.

Diplycosia calelanense ELMER, in Leafl. Philip. Bot. 3 (1911) 1103; *D. calelanensis* MERRILL, Enum. Philip. Fl. Pl. 3 (1923) 246.

Diplycosia glabra MERRILL in Philip. Journ. Sci. 14 (1919) 442, Enum. Philip. Fl. Pl. (1923) 246.

Planta lignosa, terrestris vel epiphytica, ad 4 m alta, caulibus glabris vel ramulis juvenilibus rare setosis; folia alterna, petiolis c. 5 mm longis, laminis subcoriaceis 3–6 cm longis, 1–4 cm latis, figura mutabilissima, oblonga, elliptica, ovata, obovata, vel oblanceolata, basi rotundatis ad cuneatis, apice rotundatis, obtusis, vel acutis, rare acuminatis, saepissime apiculatis, glabris setulis marginalis raris exceptis, supra lucidis, subtus punctatis,

margine recurvis, integris vel distante indentulatis, venatione mutabile saepe subobsoleto; flores axillares, rare solitarii, saepius bini ad seni in fasciculis; pedicelli floriferi 2–8 mm longi, glabri, hirtelli, vel rare setosi; bracteolae 1–2 mm longae, connatae, glabrae vel in costulo hirtellae, margine basi glandulosociliatae, apice simpliciter ciliatae; calyx obconicus 3–5 mm latus, glaber, lobis 5 acutis vel obtusis, 1–1.5 mm longis, margine quasi bracteolae; corolla alba ad rosea, in sicco nigra, subglobosa, glabra, 3–5 mm longa, lobis 5 minutis; stamina 10, filamentis glabris, 2.5–3 mm longis, antheris lanceolatis vel ovatis c. 1.5 mm longis, apice bitubulosis, tubulis 0.3–0.4 mm longis; discus obscurus lobatus c. 0.3 mm altus; ovarium sphaericum glabrum, 1–1.5 mm longum stylus glaber 2–3 mm longus; pedicelli fructiferi modice creti, calyce globoso creto, c. 7 mm lato, carneo, nigro, fructum includente.

The original description reads:

A shrubby epiphyte; stems 1 m long and branched; the main branches quite rigid, the ultimate ones rather lax and flexible, covered with smooth or thinly shredded gray bark; young twigs brownish in the dry state and sparsely setose hairy but soon becoming glabrous. Leaves alternatingly scattered, ascending, flat or only slightly recurved, rigidly coriaceous, deep shining green on the glabrous upper surface; much lighter or even yellowish green beneath, drying dull brown, quite variable in size, the larger blades 4 cm long by 2 cm wide a trifle above the middle, obovate or the smaller ones oblanceolate, the entire margins subinvolute and occasionally with few hairs, cuneate at the base, rounded at the other end and with a short mucronate point, beneath punctately glandular; midrib raised beneath, impressed above, usually with 3 lateral pairs; the basal pair arising a few mm above the base and extending one half of the blade, the middle pair more conspicuous and arched clear around to the apex, the upper pair obscure or obsolete; petiole glabrous or sparsely hairy, stout, not exceeding 5 mm in length. Flowers in small axillary fascicles, subpendulous; pedicels 5 mm long, subrecurved, provided with few crisp hairs, subtended at the base by short rather thick imbricate bracts; calyx green, subtended at the base by a saucer shaped and a glandularly margined rim 3 mm wide, 5 mm long, glabrate except the glandular margins of the triangularly shaped 5 teeth; corolla greenish yellow, short cylindric, 5 mm long, nearly as wide, the 5 small recurved segments forming a truncate apex, glabrous; stamens 10, all equal and fertile; filaments also greenish, subcompressed, glabrate, 2 mm long, inserted upon the inner basal portion of the corolla tube; anthers 1.5 mm long, pulverulent, attached to the back below the middle, oblong and with truncate ends, slightly wider across the base, flattened toward and dehiscent at the apex, without appendages; ovary glabrous, superior, 2 mm wide, 1.5 mm high; style thick, 3 mm long, fusiformly thickened at the middle, also glabrate and greenish; stigma terminal, not enlarged; fruit not seen.

Type specimen 11681, *A. D. E. Elmer*, Todaya (Mt. Apo), District of Davao, Mindanao, September, 1909.

Collected in elfinwoods densely clothed with mosses and scale-mosses at 8,500 feet of Mt. Calelan. Called by the Bagobos 'Limatmat.'

Associated with other allied species of *Diplycosia*, but most closely related to the following [i. e. to *Elmer 11676*, identified as *D. luzonica*].

The original description of *D. glabra* reads:

Frutex epiphyticus, glaber, vel ramulis junioribus parcissime setosis; foliis ellipticis ad oblongo-ellipticis, acutis vel brevissime apiculatis, basi acutis, usque ad 6 cm longis, in siccitate olivaceo-brunneis vel pallidis, nitidis, nervis utrinque 2, tenuibus, supra leviter impressis, subtus obsoletis floribus axillaribus, solitariis vel fasciculatis, pedicellatis, bracteolis late ovatis, 1.5 mm longis, margine leviter ciliatis, calycis [calycibus] circiter 2 mm longis, lobis late ovatis, obtusis, 1.5 mm longis.

A glabrous, erect, epiphytic shrub, attaining a height of from 3 to 4 m, the very young branchlets sometimes with a very few slender setae. Leaves coriaceous, elliptic to oblong-elliptic, 2 to 6 cm long, 1 to 2.5 cm wide, brownish-olivaceous or pale when dry, shining, the lower surface with small scattered, brownish glands, the base acute, the apex usually acute and ending in a short, stout, blunt apiculus; lateral nerves 2 on each side of the midrib, slender, slightly impressed on the upper, obsolete on the lower surface, curved, the upper pair leaving the midrib at or near the middle of the leaf, the reticulations obsolete; petioles about 2 mm long. Flowers axillary, solitary or few in a fascicle, their pedicels about 5 mm long, the apical bracteoles connate, broadly ovate, acute or slightly acuminate, margins sparingly ciliate, 1.5 mm long. Calyx about 2 mm long, the lobes broadly ovate, obtuse, 1.5 mm long, their margins slightly ciliate. Corolla not seen. Fruit soft, fleshy, bluish-black, when dry brownish or black, about 5 mm long.

LUZON, Benguet Subprovince, Pauai, *Bur. Sci. 31784* Santos, April 22, 1918 (type), *Bur. Sci. 8509 McGregor*, June, 1909, *For. Bur. 14434 Darling*, January, 1909, *Copeland, s. n.*, May, 1913, in the mossy forest, altitude about 2,300 meters. Igorot name *dugui-is*.

Among the Philippine species this is most closely allied to *Diplycosia calelanensis* Elm., from which it is readily distinguished by its nerves being obsolete on the lower surface of the leaves. Among the extra-Philippine species its alliance is manifestly with the Javan *Diplycosia heterophylla* Blume, but its leaves are different in shape, never acuminate, with shorter petioles, while the venation is distinctly different.

MINDANAO, Davao Province, Mount Calelan, *Elmer 11681* (W; type of *D. calelanense*); Mount Matutum, *Copeland s. n.* (M). LUZON, Sorsogon Province, *Copeland s. n.* (M): Rizal Province, Montalban, *Loher 12383* (M, C); Pinauisan, *Loher 12425* (M, C): Mountain Province, Benguet Subprovince, Mount Santo Tomas, *Elmer 5932* (M, W), *Williams 1341* (M, W), *Bur. Sci. 5466 Ramos* (M, W); Baguio, *Elmer 14262* (M, W); Mount Ugo, *Bur. Sci. 5726 Ramos* (M); Pauai, *For. Bur. 14434 Darling* (M), *Bur. Sci. 8509 McGregor* (M), *Bur. Sci. 31784 Santos* (M; type of *D. glabra*).

The leaves of both of the specimens from Mindanao (typical *D. calelanensis*) are obtuse or rounded. Those of the specimens from Pauai (*D. glabra*) and from Rizal are uniformly elliptic, with acute apices; but the Rizal plants seem to be distinguishable by flowers on longer pedicels. The leaves of specimens from Mount Santo Tomas are very variable; some resemble so closely the leaves of *D. luzonica* that Merrill, with a leaf of the type specimen of *D. luzonica* before him, regarded them as typical representatives of that species, as he remarked in describing *D. merrittii*. But other leaves of these plants match perfectly those of the type specimens of *D. calelanensis* and *D. glabra*.

From a comparison of the descriptions given above with Smith's elaborate description of *D. heterophylla*, I conclude that *D. calelanensis* can be distinguished by small flower parts in general, and especially by smaller anthers; and by anthers resembling those of *D. luzonica* rather than those of *D. trinervia*.

Other closely related species are *D. punctulata* Stapf, of Borneo, and *D. edulis* Schlechter, of Northeast New Guinea.

5. DIPLYCOSIA OPACA C. B. Robinson. Plate 5, fig. 2.

Diplycosia opaca C. B. Robinson in Philip. Journ. Sci. 6 (1911) Bot. 355; Merrill, Enum. Philip. Fl. Pl. 3 (1923) 247.

The original description reads:

Arbuscula epiphytica, inflorescentiis exceptis glabra: inflorescentiis axillaribus, 1- ad 3-floris, pedicellis brevibus: foliis ellipticis, coriaceis, basi acutis, apice retusis vel rarius truncatis, crasse apiculatis, margine integris, revolutis; venis utrinque circa 3, obscuris.

Flowers in the axils of present or fallen leaves, 1 to 3 at each node, fascicled, the pedicels 2 to 4 mm long, densely covered with nearly appressed pubescence: bracts at the base of the flowers paired, ovate obtusely acuminate, 2 mm long, pubescent near the margins and ciliate, together resembling a *Cosmarium;* calyx pinkish, urceolate, 3 mm long, divided two-thirds of the way to the base into 5 imbricate, ovate, subacute or obtuse ciliate lobes; corolla still undivided, 2 to 2.5 mm long; stamens 10, 1 mm long, the filaments longer than the unappendaged anthers; ovary glabrous, less than 1 mm long, umbilicate, 5-celled, many-ovuled; style very short, the undivided stigma barely exerted [exserted] from the umbilicus.

An epiphytic shrub, about 1 m high, the vegetative parts entirely glabrous, the bark of the older stems cinnamon-brown, that of the younger branches more often gray: leaves with petioles 5 to 9 mm long, the lamina coriaceous, elliptic, 4 to 8.5 cm long, 2 to 4 cm wide, the base acute, the margins entire, revolute, the apex retuse or merely truncate, shortly and stoutly apiculate, the under surface with scattered, minute, black, glandular dots; all venation except the midrib very indistinct, but the lamina cer-

tainly triplinerved, with apparently two additional veins on each side of the midrib.

LUZON, Province of Tayabas (Infanta), Mount Binuang, in mossy forest at an elevation of 900 m, *Bur. Sci. 9385 Robinson.* The leaf-apex seems entirely different from that of any other species of the genus, at once separating it from *D. merrittii,* its nearer Philippine ally.

Known only by the type collection (M, W); this bears only immature flower buds, on which the original description of the flowers was evidently based. With doubt I hold this distinct from *D. calelanensis,* from which it differs in the larger leaves. The leaves are nearly all obtuse or rounded, but one of them is briefly acuminate, as in some collections of *D. heterophylla.*

6. DIPLYCOSIA BACLAYANENSIS Elmer.

Diplycosia baclayanensis ELMER in Leafl. Philip. Bot. 3 (1911) 1100; MERRILL, Enum. Philip. Fl. Pl. 3 (1923) 246.

Fruticulus epiphyticus (an semper?), petiolis glabris crassis 5–7 mm longis, foliis crasse coriaceis, ovatis, oblongis, vel obovatis, c. 6–7 cm longis, 3–4 cm latis, apice obtusa vel rotundata, apiculata, supra glabra, venatione impresso manifesto, margine recurvis, rare indentulatis, subtus minute punctatis, venatione subobsoleto; flores in fasciculis axillaribus (foliis subtendentibus interdum disjunctis), in pedicellis hirtellis glandulosisque, nunquam setosis, 5–8 mm longis; bracteolis c. 1.5 mm longis, glabris, margine ciliolatis et glanduloso-ciliolatis; calyx glaber, c. 4 mm longa, lobis 5 ciliolatis et glanduloso-ciliolatis; corolla alba, c. 5 mm longa, lobis 5 minutis; stamina 10, filamentis c. 2 mm longis, antheris c. 1.5 mm longis; ovarium glabrum globosum, c. 2 mm longum; stylus glaber, c. 3 mm longus.

The original description reads:

An epiphytic shrub; stem 1 to 2 m. long, rigid, branched, the larger ones 2 to 3 cm. thick ascending; wood greenish white, with a large pith; bark brown or grayish, smooth or becoming thinly shredded; twigs yellowish gray and smooth. Leaves thickly coriaceous, dull green above, much lighter beneath, ascending, the young ones reddish, flat, the entire margins rolled upon the under side in the dry state, alternatingly scattered or occasionally clustered in subwhorls, glabrous, minutely punctate beneath, ovately oblong, rounded or obscurely obtuse at the apex which is terminated by a short mucronate point, base obtuse or rounded, the median blades 7 cm. long and 4 cm. wide above the middle, drying brown; petiole 5 mm. long, also glabrous, stout, brown, deeply indented into the cortex of the branchlets; midrib conspicuous beneath, impressed on the upper side, with 2 to 4 lateral nerves on each side; the heavier pair of lateral ones arising 5 to 10 mm. from the base and curvingly extending clear to the apex, reticulations absent on both sides. Flowers waxy white, pendulous, severally clustered

from the leaf axils or axils of their scars; pedicels 8 mm. long, spreading, usually recurved, reddish and puberulent, quite slender, at the base subtended by small imbricated brown bracts; involucral disk 3 mm. across, only one half as high, glabrate except the finely pectinate more or less glandular margins; calyx 3.5 mm. long, subglabrous except the margins of the 5 teeth, greenish; corolla bluntly elliptish, white, 5 mm. long, glabrous, the short 5 teeth reflexed; stamens 10; filaments subcompressed, 2 mm. long, inserted upon the base of the corolla; anthers 1.5 mm. long, widest across the obscurely bilobed base, finely pulverulent or papillate, dorsally attached, without appendages although the apical portion is much narrower and thinner; the glabrous ovary globosely compressed, 2.25 mm. across, superior; style columnar, 3 mm. long, terminated by a minute stigma; fruit not seen.

Type specimen 11595, *A. D. E. Elmer*, Todaya (Mt. Apo), District of Davao, Mindanao, August, 1909.

Collected in a dense moss covered forested basin at 6500 feet at Baclayan or the upper camping place of mount Apo. It was taken from the lower limbs of a large tree. The Bagobo name is 'Sigbut-ta-cayo.'

MINDANAO, Davao Province, Mount Apo, *Elmer 11595* (W; cotype). LUZON, Nueva Vizcaya Province, Caraballo Mountains, *Loher s. n.* (C).

The cotype is a very poor specimen, without fruit or mature flowers, and with all of the seven leaves more or less distorted, as if by the work of insects. The specimen from Nueva Vizcaya is identified with doubt; like the cotype, it lacks flowers and fruit, although showing pedicels clearly; the leaves are in good condition. It appears from the descriptions that *D. baclayanensis* is closely related to *D. kinabaluensis* Stapf, but that the latter has flowers about twice as large.

7. DIPLYCOSIA APOENSIS Elmer. Plate 4, fig. 2.

Diplycosia apoense ELMER in Leafl. Philip. Bot 3 (1911) 1101; *D. apoensis* MERRILL, Enum. Philip. Fl. Pl. 3 (1923) 246.

Fruticulus epiphyticus vel procumbens, ramulis dense setosis; folia alterna, petiolis c. 3 mm longis, setosis; laminis ovatis, trinerviis, 2–3 cm longis, c. 1.5 cm latis, basi obtusis vel rotundatis, apice acutis vel acuminatis, supra lucidis, in juventate setosis, subtus setosis vel in senectute punctatis, margine recurvis; flores solitarii vel pauci in fasciculis, axillaris; pedicelli usque ad 5 mm longis, setosi et glandulosi; bracteolae connatae, c. 1.5 mm longae, margine glanduloso-ciliatae; flores quasi D. luzonicae.

The original description reads:

Epiphytes or sprawling over moss covered ground; stem 5 dm. long, branched; wood quite hard, covered with grayish brown bark; twigs provided with similarly colored setose hairs, the young portion densely covered

with reddish brown hairs. Leaves alternate, copiously scattered along the branchlets, elliptic, 2.5 cm. long by 1.5 cm. wide across the middle, rigidly coriaceous, shining green on the upper side and beset with strigose hairs, beneath much paler green and duller, apiculately obtuse at apex, base rounded or obtuse, the entire margins curved upon the under side, curing brown, beneath setose hairy; nerves 3 from the base, impressed on the upper side, the midrib rather conspicuous beneath clear to the apex; the lateral pair less conspicuous, subopposite, arising 1 to 3 mm. from the base, curvingly extending clear to the apex, other nerves obsolete; petiole 3 mm. long, stout, similarly hairy. Flowers solitary or few clustered from the leaf axils; pedicels at most 5 mm. long, subrecurved, scurfy brown or with crisp hairs, subtended at the base by brown and minutely fringed imbricate bracts; involucral disk broadly bilobed, 3 mm. wide across the pectinately fringed margins, only one half as high; calyx 5 mm. long, 4 mm. across, rather broad clear to the base, glabrous except the pectinately fringed glands along the margins; segments triangularly acute, one half the length of the calyx; corolla glabrous, subcampanulate, with 5 acute or obtuse slightly reflexed teeth; stamens 10, inserted near the base of the corolla; filaments glabrous, wider below the middle, 2 to 3 mm. long; anthers without horns, 2 mm. long, finely pulverulent, widest across the minutely bilobed base, dorsally attached just below the middle; ovary also glabrous, subglobose, superior; style smooth, strict, a few mm. long; stigma terminal, minute; fruit not seen.

Type specimen 11676 [b], *A. D. E. Elmer*, Todaya (Mt. Apo), District of Davao, Mindanao, September, 1909.

Discovered in elfinwoods laden with mosses and scale-mosses at the summit of mount Calelan. This as well as *D. trinervia Elm.* were collected and cured under one number, namely 11676, which is nearest but not at all typical *D. luzonica* (*Gray*) *Merr.* They can distinctly be separated at once even in the dry state. Number 11681, the type material of *D. calelanensis Elm.* is another very closely allied species.

MINDANAO, Davao Province, Mount Calelan, *Elmer 11676* [b] (M; type): Bukidnon Province, Mount Lipa, *Bur. Sci. 38545 Ramos and Edaño* (M).

Reproductive structures are represented, on the cotype which I have seen, by a single loose calyx, including a young fruit, in a pocket attached to the sheet. The Bukidnon specimen is of a very similar, perhaps more bristly plant; it has a single badly crushed fruit, black according to the field label, detached and preserved in a pocket. This was borne on a solitary bristly pedicel about 2 mm long.

This appears to be the closest among Philippine species to *D. soror, D. amboinensis,* and *D. consobrina,* of Beccari. This group is related to *D. rufa* Stapf and *D. chrysothrix* Stapf, but differs from them in having glabrous flower parts. The group represents, probably, an evolutionary transition leading to *D. parvifolia, D. microphylla,* and their allies, with small leaves and strictly solitary flowers.

8. DIPLYCOSIA PARVIFOLIA Merrill.

Diplycosia parvifolia MERRILL in Philip. Journ. Sci. 5 (1910) Bot. 211, Enum. Philip. Fl. Pl. 3 (1923) 247.

The original description reads:

Frutex parvus epiphyticus vix 1 m altus, ramulis junioribus plus minus setosis; foliis coriaceis, nitidis, ellipticis vel elliptico-oblongis, basi acutis, apice acutis vel leviter acuminatis, 1 ad 2.5 cm longis, subtus glandulosopunctatis, nervis lateralibus obsoletis, basi interdum obscure triplineriis; floribus paucis, axillaribus, solitariis, pedicellatis, calycis segmentis minute ciliatis.

A small, epiphytic, erect shrub less than 1 m high, diffusely branched, the branches slender, glabrous, brown, slightly striate, terete, the branchlets with scattered slender, brown, more or less appressed, setose hairs. Leaves coriaceous, elliptic to elliptic-oblong, 1 to 2.5 cm long, 1 cm wide or less, entire, the base acute, the apex acute or slightly acuminate, glabrous and shining when dry, but the margins of the younger leaves more or less ciliate-setose, the lower surface with scattered, dark-colored, small glands; midrib distinct, the lateral nerves and reticulations obsolete, the base sometimes very obscurely triplinerved; petioles about 2 mm long, glabrous. Flowers axillary, solitary, few, their pedicels setose, up to 7 mm in length, the corolla unknown, basal bract minute, less than 1 mm long, the apex of the pedicel with two orbicular-ovate bracteoles about 1.5 mm in diameter. Calyx glabrous except the slightly ciliate margins of the lobes, accrescent, the lobes just after anthesis ovate, acuminate, about 2 mm long; style persistent, 2 mm long.

NEGROS, Canlaon Volcano, on mossy trunks in forests at an altitude of about 1,500 m, *Merrill 6995*, April, 1910.

A species well characterized by its comparatively small leaves, the lateral nerves obsolete except sometimes the very faint subbasal pair.

NEGROS, Canlaon Volcano, *Merrill 6995* (M; type). LUZON, Ifugao Subprovince, Mount Polis, *Bur. Sci. 19704 McGregor* (M).

The specimen from Mount Polis has leaves closely resembling those of the type but somewhat bristly beneath; the stems are more bristly than those of the type, and the pedicels shorter. The flowers remain unknown, but are probably indistinguishable from those of *D. luzonica* and *D. calelanensis*. The species is doubtless very close to *D. microphylla* Becc. Ridley has described two other species, *D. elliptica* and *D. cordifolia*, which inhabit the Malay Peninsula and belong close to *D. microphylla*.

9. DIPLYCOSIA sp. indet. Plate 5, fig. 3.

An epiphytic shrub with ovate-acute, thickly coriaceous leaves 3–5 cm long, lucid above, bristly beneath, 3-nerved but the lateral nerves nearly obsolete, margins entire; the fleshy black fruit-bearing calyces solitary or paired, on bristly pedicels about 8 mm long.

CATANDUANES, Mount Mariguidon, 277 m, *Bur. Sci. 30318 Ramos and Chan* (M, W), November 14, 1917.

The entire and coriaceous character of the leaves, and the fruits one or two in a cluster, seem to separate this from *D. luzonica.*

10. DIPLYCOSIA sp. indet.

Diplycosia luzonica ELMER in Leafl. Philip. Bot. 3 (1911) 1105, non Merrill.

Elmer gives the following:

Field-note:—Epiphytic shrub, upon the larger or lower limbs of trees at 8500 feet or near the summit of mount Calelan; stems 3 feet long, tough, branched especially above the middle, its bark smooth and brown; twigs chiefly ascending, brown or grayish, provided with brown hairs; leaves ascending, flat or only slightly recurved, shining dark green above, much paler beneath, the petiole and young foliage red; pedicels green or reddish, recurved; calyx green or the segment tips reddish brown; corolla 0.33 inch long, greenish, not tapering nor constricted toward the apex. 'Sagumati' is the Bagobo name.

Represented by number 11676, *Elmer*, Todaya (Mt. Apo), Mindanao, September, 1909.

The elliptic obtuse leaves about 3.5 cm long, on well-developed petioles, are essentially glabrous. The flowers are solitary or in pairs on glabrescent pedicels 6 to 8 mm long. The stamens, about 1.5 mm long, open through introrse slits 0.5 mm long, not by terminal pores nor by very brief subterminal slits. This character might justify the publication of a new species, but it is very obscure, and I have not seen enough material to be sure it is reliable.

Genus IAERA novum

Plantae lignosae, saepissime vel semper epiphyticae, ramulis juvenilibus interdum exceptis glabrae; folia alterna, integra, crassa, nervis subdigitatis adscendentibus, petiolis utroque latere conspicue uniglandulosis; flores solitarii vel fasciculati, axillares vel extra-axillares, pedicellis basi bracteatis (bracteis 2–6, minutis, decussatis), sub ovario non articulatis; calyx 5-partitus; corolla sympetala, minuta, alba, 5-partita; stamina 10; filamenta applanata, ciliolata (ciliolis paucis, applanatis), apice abrupte incurva; antherae dorsifixae; thecae muticae, dimidiis superioribus in tubulos attenuatis, per rimas breves subapicales introrsas dehiscentes; discus minutus stylum terete corollae subaequilongum subtendens; ovarium inferum 5-loculatum, ovulis c. 5 in quoque loculo, placentis axialibus; bacca parva, seminibus ovoideis foveolatis. Typus, Vaccinium lanaense *Merrill.* (Iaera: nomen cuiusdam oreadis.)

I can assign to *Iaera* only the three Philippine species listed below. These species have leathery leaves, with a single conspicuous gland on each side of the petiole; solitary or fascicled flowers with minute corollas; the pedicel not articulate to the ovary; filaments with a row of flattened trichomes along each edge; anthers attenuate, without horns; seeds few (about twenty-five) in the five-celled ovary; surface of the seeds, as seen under the dissecting lens, conspicuously pitted. For the present, I treat all the above characters as generic characters; one may expect the discovery of new species, obviously belonging to this genus, but with characters that will require the modification of the generic description.

The Formosan *Vaccinium merrillianum* Hayata appears to show similarities. Two Bornean plants, *V. uniflorum* J. J. Smith and *V. monanthum* Ridley, appear to be similar; but the original descriptions of these species fail to mention some of the characters that would permit me to decide whether they should be transferred.

Key to the species.

1. Leaves 5 cm long or longer.
   2. Pedicels scarcely 5 mm long, leaves ovate or lanceolate, usually acuminate ..... 1. *I. lanaensis.*
   2. Pedicels over 1 cm long, leaves elliptic or obovate, obtuse or rounded ..... 2. *I. lucida.*
1. Leaves scarcely 2 cm long, elliptic or obovate, obtuse or rounded. 3. *I. loheri.*

1. IAERA LANAENSIS (Merrill) comb. nov. Plate 6, figs. 1–6.

Vaccinium lanaense MERRILL in Philip. Journ. Sci. 3 (1908) Bot. 161, 372, Enum. Philip. Fl. Pl. 3 (1923) 250.

Vaccinium medinilloides ELMER in Leafl. Philip. Bot. 3 (1911) 1097.

The original description reads:

Arbor vel arbuscula, glabra, epiphytica; foliis coriaceis, ovatis vel oblongo-ovatis, 6 ad 11 cm longis, acuminatis, basi valde 5–7-nerviis; floribus axillaribus, fasciculatis, parvis, corolla ca. 2 mm longa, cylindrica, glabra; fructibus ovoideis, 4–5 mm diam.

An epiphytic shrub or tree, glabrous throughout, the branches light gray or pale brown, terete. Leaves ovate or oblong-ovate, rarely ovate-lanceolate, 6 to 7 cm long, 2 to 6 cm wide, coriaceous, shining, apex rather strongly acuminate, base rounded to subacute, the margins entire, somewhat revolute; nerves basal or subbasal, prominent, 5, sometimes with an additional submarginal pair, the interior pair leaving the midrib shortly above the base and extending nearly to the apex of the leaf, the reticulations obscure; petioles stout, about 3 mm long. Flowers in axillary 2- to 5-flowered fascicles, the pedicels, glabrous, 3 to 4 mm long, each subtended by a pair of small somewhat sheathing bracteoles. Calyx glabrous, 2 to 2.5 mm long, the limb short, somewhat spreading, the lobes broadly orbi-

cular-ovate, acute or acuminate, about 0.7 mm long. Corolla glabrous, cylindrical, short, 2.5 mm long or less, the teeth broadly ovate, about 1 mm long. Stamens 10; filaments 1.5 mm long or less, slightly hirsute, the anthers about 1.2 mm long. Style glabrous, deciduous, 2 mm long; stigma capitate. Fruit ovoid, glabrous, 4 to 5 mm in diameter.

MINDANAO, Lake Lanao, Camp Keithley, *Mrs. Clemens 431*, March and June, 1906, also without numbers, September–October, 1906, September, 1907, and October, 1907.

An epiphytic species, growing on *Ficus*, in leaf-characters, shape, size, texture, and venation, very close to *Vaccinium apoanum* Merr., but entirely different in floral characters, well distinguished by its small entirely glabrous flowers.

The original description of *Vaccinium medinilloides* reads:

An epiphyte; stems several in the clump, 1.5 m. long, rigid, branched, 2 cm. thick, covered with smooth gray bark; twigs greenish or brown in the dry state, the young portion finely sericeous, the slender free ends descending. Leaves very rigid, easily breaking with a snap, flat or the acuminate tips only recurved, darker green on the upper side, glabrous, dull green when dry, entire margins somewhat involute, the base of the larger ones rounded, obtuse in the others, ovately oblong or the smaller blades broadly lanceolate, 10 to 15 cm. long or much shorter, 3.5 to 5.5 cm. wide below the middle, alternatingly scattered along the branches; nerves conspicuous on both sides, the 3 lateral ones subparallel and arising from below the middle, the upper ones of these main lateral nerves arched and extending clear to the apex, reticulations visible from both sides but not conspicuous; petiole suberect, glabrous, stout, dark brown in the dry state, up to 7.5 mm long, with a pair of large lateral glands above the middle. Flowers not seen; fruits in small fascicles, axillary or from the axils or fallen leaves; pedicels strict, glabrate, 5 mm. long, spreading, subtended at the base by minutely imbricated bracts; green fruit globose, glabrous, 5 mm. in diameter, bearing the persistent 5-toothed calyx, 5-celled and about 30-seeded; seeds obscurely trigonous, dark brown, 1.5 mm. long, minutely pitted and usually glistening.

Type specimen 11310, *A. D. E. Elmer*, Todaya (Mt. Apo), District of Davao, Mindanao, August, 1909.

Upon limbs of large trees in a humid forested basin, near the Baruring river at 4000 feet. It has the facies of *Medinilla*, and is called 'Lumoos' by the Bagobos.

It falls under the same group with *V. apoanum Merr.* and *V. calelanum Elm.*, but is entirely distinct from either.

MINDANAO, Lanao Province, Camp Keithley, *Clemens 431* (M; type of *Vaccinium lanaense*), *Clemens 431a* (M), *Clemens s. n.* (M, 3 sheets, W, 2 sheets): Zamboanga Province, Sax River Mountains, *Merrill 8301, 8307* (M); Davao Province, Mount Apo, *Elmer 11310* (M, W; type of *Vaccinium medinilloides*). NEGROS, Negros Oriental Province, Cuernos Mountains, *Elmer 10103* (M). PANAY, Capiz Province, Mount Bulilao, *Bur. Sci. 35683 Martelino and Edaño* (M).

The type specimen was growing on the same tree as the type of *Rhododendron nortoniæ*. The flowers are always white, so far as the field labels give this information; the plant is always, so far as the labels tell, an epiphyte. The reported altitudes are from about 700 (Mount Bulilao) to about 1,300 meters (Mount Apo). This, unlike our numerous *Rhododendra* and *Vaccinia* inhabiting the mossy forest, is apparently a plant of the taller forest of lower altitudes, in which epiphytes are not easily collected.

2. IAERA LUCIDA (Merrill) comb. nov. Plate 6, figs. 7–9.

Diplycosia lucida MERRILL in Philip. Journ. Sci. 11 (1916) Bot. 28.
Vaccinium costeroides MERRILL, Enum. Philip. Fl. Pl. 3 (1923) 248.

The original description reads:

Frutex scandens glaber, ramis ramulisque teretibus; foliis ellipticis, coriaceis, nitidis, usque ad 7 cm longis, apice obtusis vel rotundatis, basi acutis, margine revolutis, integris, nervis utrinque 2 vel 3, adscendentibus, distinctis; floribus axillaribus, binis, longe pedicellatis; fructibus ovoideis, in siccitate circiter 5 mm longis.

An entirely glabrous scandent shrub, the branches and branchlets slender, terete, pale or brownish, smooth. Leaves coriaceous, shining, elliptic, 5 to 7 cm long, 2.5 to 3.5 cm wide, the apex rounded or obtuse, base acute, margins entire, revolute; lateral nerves 2 or 3 on each side of the midrib, rather prominent, ascending, the reticulations lax; petioles about 7 mm long. Flowers in axillary pairs, their pedicels slender, about 1.5 cm long. Corolla glabrous, cylindric, about 3 mm long, the lobes 5, broadly ovate, 0.5 mm long. Stamens 10, the filaments 1.7 mm long, slightly pubescent; anthers about 1 mm long. Fruit black when dry, obovoid, about 5 mm long, the persistent calyx teeth broad, short, apiculate.

LUZON, Province of Sorsogon, Mount Kililibong, *Bur. Sci. 23504 Ramos*, August 17, 1915, on trees at the summit, apparently at an altitude of about 1,000 meters.

A species well characterized by being entirely glabrous, by its obtuse or rounded leaves with revolute margins, and by its axillary pairs of long-pedicelled flowers. It somewhat resembles *Diplycosia baclayanensis* Elm., but differs in its leaf characters and in its long pedicels.

Known only by the type collection (M, W). The words of the field label, as to habitat, are "on tree summit," apparently meaning that the plant was an epiphyte on the summit of the mountain. The color of the flowers is not noted. The slender style, with a club-shaped apex, is about 2.5 mm long. The brownish pitted seeds, about 26 in the fruit, are about 1.5 mm long.

3. IAERA LOHERI (Merrill) comb. nov. Plate 7, figs. 1–5.

Vaccinium loheri MERRILL in Philip. Journ. Sci. 7 (1912) Bot. 323, Enum. Philip. Fl. Pl. 3 (1923) 250.

The original description reads:

Frutex parvus, epiphyticus, glaber; foliis crasse coriaceis, ellipticis, in siccitate pallidis, nitidis, 1.5 ad 2 cm longis, integris, apice rotundatis, basi obscure triplinerviis, acutis, 2-glandulosis, petiolo vix 2 mm longo; floribus solitariis, axillaribus, pedicellatis.

A small epiphytic, glabrous shrub, the branches terete, grayish, the younger ones reddish brown, wrinkled when dry. Leaves numerous crowded, elliptic, 1.5 to 2 cm long, thickly coriaceous, when dry rather pale and shining, the apex rounded, the base acute, with two prominent glands near the juncture with the petiole, the margins thickened, somewhat recurved, base obscurely 3-plinerved, the lateral nerves nearly as prominent as the midrib, nearly or quite reaching the apex, the reticulations obsolete or nearly so; petioles 1 to 2 mm long. Flowers white, according to the collector (corolla not seen). Pedicels solitary, axillary, slender, about 6 mm long, somewhat curved, the basal bracteoles ovate, about 0.5 mm long. Calyx 2 mm long, broadly urceolate, the tube ovoid, globose, about 1.5 mm in diameter, the limb somewhat spreading, 5-toothed, the teeth broadly triangular-ovate, acute or slightly acuminate, 0.5 mm long.

LUZON, Province of Rizal, Montalban; that is, in the mountains back of Montalban, *Loher 6187*, April 18, 1905.

Although my specimen is imperfect, the corolla being lacking, I have not hesitated to describe this distinct form. It is well characterized by its small, crowded, entire, obtuse, obscurely nerved leaves which are rounded at the apex, acute and 2-glandular at the base, and by its solitary, axillary flowers. Among Philippine species it is most closely allied to *Vaccinium microphyllum* Blume (*V. mindorense* Rendle), but is very different from that species.

LUZON, Rizal Province, Montalban, *Loher 6187* (M, W; type), *Loher 13248* (M, C).

Loher usually neglected the taking of any field notes; he made a useful exception in the case of the type sheet of this species, on the label of which one reads, in his hand, "Fl. alb. epiphytic." On his second collection cited above, flowers in bud were found. The stamens, which, in the buds observed, were about 1.2 mm long, have exactly the structure of those of the other species of *Iaera*. The fruit is about 3 mm in diameter, the pitted seeds about 1.2 mm long.

Genus DIMORPHANTHERA F. von Mueller

The eminent Baron Ferdinand von Mueller was a man of great industry, and became an object of admiration and envy to the other botanists of the world. But living away from personal contact with his fellow botanists, he committed, occasionally, annoying breaches of phytographic good form. He was able to write fluently in Latin, but frequently described new groups in English. In one passage he managed to identify

a certain specimen as *Rhododendron lowii*, and at the same time to describe it as a new species, *R. megalostigma*. The name *Dimorphanthera*, credited to him as a generic name, first appears [19] in a specific description under the following heading:

AGAPETES MOORHOUSIANA.

(DIMORPHANTHERA MOORHOUSIANA.)

The discussion following the description proper includes the following passage:

> Biformous anthers are not on record among Vaccinieae, except in Agapetes amblyornidis and A. meliphagidum, concerning which Dr. Beccari noted (Malesia I, 208 and 209) similarly dimorphous stamens, attributing however two contiguous cells to smaller anthers of those plants. I have therefore left this new species though reluctantly in the genus Agapetes, as the fruit also remains unknown. Nevertheless it would be best, to separate these three Papuan plants under the generic appellation Dimorphanthera. The five shorter one-celled anthers of our plant resemble much those of the Andine genus Macleania, which likewise has the calyx-limb undivided. From D. amblyornidis our plant differs specifically in much shorter petioles, smaller leaves and flowers, and further in the calyces not being denticulated, probably also in the fruit. From D. meliphagidum ours is more distinct, thus it has neither the prolongation of the connective of the anthers. Dr. Beccari mentions that these kinds of plants are much frequented by honey-sucking birds.

In the same year he referred another new species, *Agapetes forbesii*,[20] to *Dimorphanthera*, treating this quite definitely as a subgeneric group. He appears first definitely to have used *Dimorphanthera* as a generic name in 1890,[21] when *D. forbesii* was included in a list of recently described plants from New Guinea, without description. Warburg [22] used *Dimorphanthera* as a generic name; Drude [23] treated the group as a subgenus of *Agapetes*, and furnished, for the first time, a formal description; of the four species then known, he recognized only two, *A. forbesii* and *A. meliphagidium*. Koorders [24] followed Drude in including these plants in *Agapetes*. J. J. Smith, in several works, and Schlechter,[25] give the group the generic rank which, in my opinion, is proper.

[19] In Wing's Southern Science Record n. s. 2 (February, 1886). I have not seen the original, but the reprint in Bot. Centralbl. 26 (1886) 163.

[20] In Journ. of Bot. 24 (October 1886) 290.

[21] Descr. Notes Papuan Pl. 9 (1890) 63.

[22] Engler's Bot. Jahrb. 18 (1894) 203.

[23] Natürl. Pflanzenfam. 4:1 (1891) 55.

[24] In Nova Guinea 8 (1912) 885 et seq.

[25] In Engler's Bot. Jahrb. 55 (1918) 184.

This history illustrates the fact that irrespective of rules to the contrary, genera may be established without ever being formally raised to that rank and without being described, if they are duly typified and if botanists in general become aware of them and accept them. The type is definitely *Dimorphanthera moorhousiana,* because it was in connection with that species that the name was first used; this is true in spite of the fact that the first combination unequivocally made under the generic name was *Dimorphanthera forbesii,* and likewise in spite of the fact that *Agapetes moorhousiana* was overlooked in Drude's first formal description of the group. The recognition of the type becomes important in determining the application of sectional names.

Schlechter, in his treatment of the group in 1918, commented on the remarkable increase in number of known species that had occurred in the previous few years. He recognized twenty-seven species, all except one in New Guinea, the exception in the Philippines. Since Schlechter's work, only one new species, *D. mindanaensis* Merrill, has been described; but the number must be increased by several which Schlechter overlooked, namely *D. pulchra* J. J. Smith, in Amboina, and three species described by Wernham [26] from the collections of the Wollaston Expedition to Dutch New Guinea. One species is to be subtracted in view of J. J. Smith's reduction [27] of *D. d'Armandvillei* to *D. wrightiana;* this leaves a total of thirty-one species, with a possible thirty-second to be mentioned below.

The genus was first divided into sections by Wernham, who separated two species with longitudinally ribbed calyces, as in *Pentapterygium,* to form a section *Pteridosiphon.* Only these two species are positively known as belonging to the section; a possible third species, and thirty-second of the genus, is *Agapetes costata* Wright, of British New Guinea. J. J. Smith [28] remarked that the original description leaves it uncertain whether this species is to be transferred to *Vaccinium* or to *Dimorphanthera;* the description does, however, emphasize the ribbed character of the calyx.

Wernham referred all the rest of the species to a section *Cyclosiphon,* the type of which section is evidently the type of

[26] In Trans. Linn. Soc. Bot. 9 (1916) 89–90.
[27] In Nova Guinea 12 (1917) 516.
[28] Op. cit. 520.

the genus. Two years later Schlechter, in ignorance of Wernham's work, and of the existence of anything of the *Pteridosiphon* type, divided the genus into two sections: *Brachycone,* with campanulate corollas generally less than 2 cm long, and *Trochilanthe,* with tubular corollas generally over 2 cm long. These are apparently natural groups, and are accordingly to be maintained; but as *Cyclosiphon* is an older name for the type section, this name is to replace *Brachycone* Schlechter as the name of the section including *D. moorhousiana.*

Section *Cyclosiphon* includes twelve species, among which are all of the three known from outside of new Guinea; although these—*D. pulchra* and the two Philippine species—have the flowers in axillary fascicles instead of in racemes, as do at least many of the New Guinean species. Section *Trochilanthe,* of which *D. amblyornidis* (Beccari) F. von Mueller may be regarded as the type, includes seventeen species.

Key to the Philippine species.

1. Corolla externally pubescent ..... 1. *D. apoana.*
1. Corolla externally glabrous ..... 2. *D. mindanaensis.*

1. DIMORPHANTHERA APOANA (Merrill) Schlechter. Plate 7, figs. 6-7; 8, figs. 1-4.

Dimorphanthera apoana (Merrill) Schlechter in Engler's Bot. Jahrb. 55 (1918) 185; Merrill, Enum. Philip. Fl. Pl. 3 (1923) 252.
Vaccinium apoanum Merrill in Govt. Lab. Publ. (Philip.) 29 (1905) 39, Philip. Journ. Sci. 3 (1908) Bot. 372; Elmer in Leafl. Philip. Bot. 3 (1911) 1091.
Vaccinium calelanum Elmer in Leafl. Philip. Bot. 3 (1911) 1096.

The original description, under *Vaccinium,* reads:

A tree reaching a height of 10 m. with elliptical-oblong, sharply acuminate leaves, the flowers in axillary bracteate fascicles of from 3 to 6 in a fascicle. Branches reddish brown, glabrous. Leaves 7 to 11 cm. long, 3.5 to 6 cm. wide, glabrous, coriaceous, the base acute, 5 to 7 nerved from near the base, the outer pair of nerves obscure, the inner ones very prominent, especially beneath, sharply ascending; petioles 1 cm. long. Fascicles axillary, the peduncles glabrous, 1 cm. long, the bracts imbricate, ovate, rusty pubescent on the outside. Calyx cylindrical, 4 mm. long, 3 mm. in diameter, truncate, glabrous, the teeth small. Corolla 13 mm. long, pubescent, tubular-campanulate, the lobes about 3 mm long, rounded, reflexed. Stamens 10, the filaments thick, 2.5 mm. long, the anthers 3 to 4 mm. long. Fruit unknown.

Type specimen No. 1103 (Copeland), Mount Apo, District of Davao, Mindanao, April, 1904. A tree reaching a height of 10 m. and a diameter of 30 cm., the wood white. The vegetative characters are very similar to those of *Vaccinium barandanum* Vidal.

Elmer gives the following field note, with regard to a specimen identified as *Vaccinium apoanum:*

An epiphytic shrub, on the upper rigid limbs of trees on a wind swept ridge at 3,500 feet of mount Burebid; stems numerous from the same root cluster, ascending and interlaced, forming dense bushes, 6 feet high, the larger ones 1.5 inch thick and freely rebranched, wood watery white, not hard, sweetish, odorless; bark brown, on the stems thinly checked, smooth on the more or less slender and numerous branchlets; leaves rigid, flat, ascending, paler green beneath; flowers deep flesh red, pendulous, upon strongly recurved green pedicels, odorless. The Bagobos call it 'Tahima.'

Represented by number 11258, *Elmer*, Todaya (Mt. Apo), Mindanao, August, 1909.

These specimens are typical and are always epiphytic shrubs, never trees 20 feet high with stems a foot thick.

The original description of *Vaccinium calelanum* reads:

Epiphytic; stems usually several, 2 m. long, inclined to creep or sprawl, rigid, only sparingly branched, its gray bark usually checked, the twigs brownish and puberulent. Leaves alternate or indefinitely whorled at the basal portion of the relatively short and gnarly branchlets, ascending, rigid, with recurved acute or acuminate tips, shining deep green on the upper side, much paler green and sprinkled with glands on the lower surface, otherwise glabrous, rounded or subtruncate at the base, exceedingly variable in size, entire, characteristically brown in the dry state, the larger blades 8 dm. [cm] long and 4 cm. wide below the middle, frequently much smaller and occasionally larger, ovately oblong, the smaller ones distinctly ovate with a slender tip; petiole thick, dark brown, puberulent, 5 mm. long; midrib conspicuous beneath especially toward the base, with 2 lateral pairs arising from near the base, the upper lateral pair stronger and curvingly arched clear into the apex, reticulations none. Inflorescence sessile, clustered, axillary; the subtending bracts large, rigid, imbricate, broadly rounded or rotund, the basal ones much reduced and subglabrous except the ciliate margins, the other short but densely ferruginous pubescent; bracteoles 2, subtending the pedicels or attached to them at the base, ovate in outline, 3 mm. long, the acute apex ciliate, the lateral margins brown winged; pedicels stout, at most 1 cm. long, glabrate, usually recurved; calyx glabrous, 5 mm. long or shorter, cupshaped, truncate at the base, more or less angular even in the dry state, dark green. bearing 5 short and broad teeth; buds short yellowish gray pubescent, oblong; corolla deep red, turbinate, 12.5 mm. long, with 5 short obtuse or longer and acute teeth, veiny; stamens 10, inserted upon the base of the corolla and falling with it; filaments flattened the whole length, 3 mm. long, glabrous or only sparsely strigose on the outer side toward the top, anthers beakless or with only very short ones, 4 mm. long, oblong, dorsally attached toward the base, the blunt basal portion inwardly curved, the upper one half divided, dehiscent through large longitudinal slits on the ventral side; style smooth, nearly 15 mm. long, terete, reddish, terminated by a small red stigma; ovary inferior; fruit not seen.

Type specimen 11345, *A. D. E. Elmer*, Todaya (Mt. Apo), District of Davao, Mindanao, August, 1909.

Collected on small trees scattered among interlaced shrubs in the mossy woods at 7,750 feet of mount Calelan. The Bagobos call it 'Calumping.'

A critical segregate from *V. apoanum Merr.*, but the leaves differently shaped, calyx distinctly toothed and with other minor floral characters. The ripe fruits for both of them are unknown.

In transferring the species to *Dimorphanthera,* Schlechter remarks merely that "die einzige bisher ausserpapuasische Art ist *Dimorphanthera apoana* (Merr.) Schltr. (*Vaccinium apoanum* Merr.), eine Pflanze der Gebirgswälder auf der Insel Negros von den Philippinen," and that the species belongs to his section *Brachycone.*

MINDANAO, Davao Province, Mount Apo, *Copeland 1105* (M, W, type), *Williams 2550* (M, W), *Elmer 11258* (M, W), *Clemens 15681* (C); Mount Calelan, *Elmer 11435* (W, type of *Vaccinium calelanum*): Bukidnon Province, Mount Candoön, *Bur. Sci. 38914 Ramos and Edaño* (M, W). NEGROS, Mount Silay, *Whitford 1497* (M, W); Canlaon Volcano, *Merrill Philippine Plants 224* (M, W). PANAY, Antique Province, *Yoder s. n.* (M).

At altitudes from 1,200 to 2,600 meters, both extremes collected by Elmer in the Mount Apo region.

The character of all the non-Philippine species, and the positive statements of Elmer, cast doubt upon the observation of E. B. Copeland, who wrote on the field label of the type specimen "Tree 35 ft. high, 1 ft. in diam. Wood white." Williams's succinct note reads "1 in x 15 ft." Whitford wrote "vine?"; Merrill, "Epiphytic shrub 2–3 m." The remaining collections are without notes as to habit. If all of these notes are correct, a greater variability than is usual even in shrubs of the mossy forest is indicated.

The stems are glabrous, except in *Elmer 11435,* and it is possible that *V. calelanum* will sometime be found tenable, as a species, by this character. The petioles are pubescent in about half of the collections, glabrous in the others; they are stout, terete, rather less than 1 cm long. The somewhat coriaceous, entire, usually acuminate, leaves vary greatly in size and to some extent in shape and in the number of the main palmate nerves. The upper surface is glabrous, the lower sometimes punctate, sometimes with scattered apparently glandular hairs, sometimes glabrous; *V. calelanum* cannot be distnguished by leaf characters. Merrill and Elmer have mentioned the suborbicular imbricate bracts less than 1 cm long that surround the flower clusters, and Elmer has described the paired bracteoles on the bases of the glabrous pedicels. The calyx teeth are al-

ways distinguishable, rounded, with a brief apiculation. The campanulate pubescent red corolla is 9 to 13 mm long; the lobes are briefly acuminate and become reflexed in age, while the style becomes exserted. The filaments are 1 to 2 mm long, separate, flattened, with a few hairs on the backs and margins. The oval small anthers, 2 to 3 mm long, are strongly projected forward at the base; each bears on the back, as upward projections of the connective, two obscure horns which do not reach the summit of the tubes. The larger anthers, of the shape well described by Schlechter as obsagittate, are about 3.5 mm long; each bears on the back of each tube a flattened ascending scale reaching as far as the summit of the tube. The disk is prominent; the ovary is strictly 5-celled; the axile placentæ, bearing very numerous ovules, project strongly into the cells. The Manila specimen of *Williams 2250* was found to bear a cluster of three apparently mature fruits; these were borne on pedicels that had become thicker but not much longer than when in flower, and were apparently black and fleshy, 9 mm in diameter crowned by the disk 3 mm in diameter and the 5-toothed calyx limb 6 mm in diameter. The elongate seeds are about 1 mm long, brown, with a very finely striate or reticulate surface.

2. DIMORPHANTHERA MINDANAENSIS Merrill.

Dimorphanthera mindanaensis MERRILL in Philip. Journ. Sci. 20 (1922) 418, Enum. Philip. Fl. Pl. 3 (1923) 252.

The original description reads:

Species D. apoanae Schltr. affinis differt floribus glabris.

A shrub, entirely glabrous except the bracts enclosing the inflorescences, the branches and branchlets rather stout, reddish brown when dry or sometimes nearly black. Leaves thickly coriaceous, ovate to elliptic, brownish when dry, 4 to 8 cm long, 2.5 to 4.5 cm wide, somewhat shining, the apex shortly acuminate, the base acute to rounded and usually 5-nerved, sometimes with an additional pair of slender marginal nerves, the inner nerves leaving the midrib 4 to 8 mm above the base, the reticulations rather lax; petioles 4 to 8 mm long, rather stout. Flowers fascicled in the uppermost axils, the young buds entirely enclosed by numerous, imbricate, brown, sparingly pubescent, concave bracts forming a cylindrical head about 1 cm in diameter, some of the bracts subpersistent, others deciduous. Pedicels up to 10 mm long. Calyx glabrous, about 3.5 mm long, shallowly 5-lobed, the lobes broadly ovate, shortly and abruptly acuminate. Corolla red, 8 to 10 mm long, glabrous, somewhat widened upward, the lobes ovate, about 3 mm long. Stamens 10, glabrous, dimorphous, the larger ones with filaments and anthers about 4 mm long, the shorter ones with filaments 3 mm long and anthers about 2 mm long. Styles 12 mm long, glabrous. Fruits unknown.

MINDANAO, Misamis Province, Mount Malindang, *For. Bur. 4708 Mearns and Hutchinson*, May, 1906. In the mossy forest, altitude about 1,700

meters. The same species is apparently represented by *Bur. Sci. 38537 Ramos and Edaño* from Mount Lipa, Bukidnon Subprovince, Mindanao, July, 1920.

Both specimens were originally identified as *Vaccinium apoanum* Merr. = *Dimorphanthera apoana* Schltr. but, like that species, are true representatives of the genus *Dimorphanthera*, differing from the latter especially in the glabrous flowers. It is the second species of the genus to be found in the Philippines, *Dimorphanthera* being now known otherwise only from New Guinea and Amboina, with twenty-seven species in New Guinea and one in Amboina.

This species is known only by the two collections cited in the original description, and these are represented, apparently, only in the herbarium of the Bureau of Science at Manila. Although distinguished only by a single character of moderate weight, the species may be maintained, at least for the present.

GENERAL REMARKS

It is of the nature of modern science, and conspicuously true of taxonomy, that the published statement of any particular piece of work is in a sense preliminary, a progress report, a contribution; never a full and final statement of the truth on its subject. The present work should lead both to a more intensive study of the Philippine Ericaceæ, and to a more extensive study of Ericaceæ in general. As to the Philippine plants, the problems here solved appear to be fewer than those revealed as not yet soluble. As to Ericaceæ in general, any advance in knowledge is certain to be reflected in a better understanding of the Philippine representatives of the family. This applies especially to the family as represented in the Malay region, because most of the Philippine plants have come from the south, at least in the sense that their ancestors lived there. A summary of existing knowledge and opinion, with regard to the taxonomy of Ericaceæ in general, and in the Malay region in particular, may form an appropriate conclusion to the present work.

THE CLASSIFICATION AND RELATIONSHIPS OF THE ERICACEÆ

My studies of the Ericaceæ, based both on material and on the literature, have been confined to gross morphology, and the remarks about to be presented lack the valuable foundation and the completeness in detail to be obtained by studies of minute anatomy and of ontogeny.

The family was satisfactorily arranged by Drude, in the Natürlichen Pflanzenfamilien (1891), in four subfamilies; the first three with the corolla deciduous, not papery.

1. Rhododendroideæ: ovary superior; fruit a septicidal capsule.

2. Arbutoideæ: ovary superior; fruit a capsule, not septicidal, or a berry.

3. Vaccinoideæ: ovary inferior; fruit a berry.

The fourth subfamily, in which the papery corolla is persistent after flowering, is—

4. Ericoideæ: ovary superior, fruit variable. Of this group, the geographic distribution of which is comparatively limited, I shall have no more to say.

There is no doubt that these groups are closely related to one another, and to the families Pyrolaceæ and Clethraceæ. Likewise, if carpels are homologous with leaves, it cannot be doubted that the Rhododendroideæ, in which the carpels finally separate practically as units, and some of which, furthermore, have separate petals, are the most primitive members of the alliance.

Where have the Ericaceæ been placed in systems of classification? In treating the Sympetalæ, the earlier authors, such as the de Candolles, Gray, and Bentham and Hooker, named first the Inferæ, culminating in the Compositæ and other Campanulatæ; then the Ericales, with the Vaccinioideæ first; then the Myrsinaceæ, the Primulaceæ, and the rest of the Sympetalæ. I think I do these authors no injustice in understanding this arrangement as implying the belief that the Ericales represent a transition from the Sympetalæ with inferior ovaries to those with superior ovaries. This view has long since been abandoned.

Eichler, and Engler and Prantl, placed the Ericales first among the orders of Sympetalæ. This treatment gives no hint of any hypothesis as to the origin of the group; there is certainly no implication of derivation from Umbellifloræ. On the other hand, I gather the implication that the Ericales are close to Primulales, and more or less representative of the ancestors of all the Sympetalæ. Any such disposition is, I am convinced, to be abandoned; Primulaceæ appear to be an offshoot of Centrospermæ; the Ericales are the highly developed end of some other line, and have given rise to no further developments.

As a guide in the search for ancestors to the Ericaceæ, we make up a hypothetical description, chiefly from the characters of the Rhododendroideæ. Such a description reads about as follows: Woody plants, with simple leaves, beset with trichomes; flowers with the parts in sets of five or more, polypetalous; stamens twice as many as the petals or even more numerous; an-

thers opening by terminal pores; disk present; ovules numerous on axile placentæ; fruit a septicidal capsule.

Saurauia, a genus widespread and numerous in species, comes very close to perfect agreement with this hypothetical description. The connection between *Saurauia* and the Ericaceæ seems first to have been noticed by Lindley,[29] who wrote:

> The genus Saurauja is usually stationed among Theads (Ternstroemiaceae), from which its minute embryo, indefinite seeds, and very copious albumen remove it. From Dilleniads it differs in the want of an aril, and in little else that can be regarded as essential; for its styles, which are divided to the very base, afford conclusive evidence as to its having a tendency to disunite its carpels. If it were not for that circumstance, and its indefinite stamens, it might be placed among Heathworts, of which it has the embryo, the minute indefinite seeds, a tendency to form a monopetalous corolla, and anthers opening by pores. I can scarcely doubt that it forms a complete transition from the Ranal to the Erical Alliance.

This view was noticed with interest by de Vriese,[30] and was applied in classification by Hallier.

Various hints support the view that the resemblance between *Saurauia* and the Ericaceæ is a mark of relationship. In *Saurauia* and the closely related genus *Clematoclethra* the stamens in bud are arched outward so that the anthers are borne in an inverted position; at anthesis, the anthers turn right side up. Exactly the same thing happens with stamens of remarkably similar appearance in Pyrolaceæ and Clethraceæ. Certain mistakes of the past may be mentioned. The name *Clematoclethra* reminds us that this group was described by Franchet as a section of *Clethra. Mischopleura,* described by Wernham as a new genus of Ericaceæ, ceases to be a puzzle when assigned to the neighborhood of the great dilleniaceous genus *Hibbertia.* Such evidence cannot be pressed too far; from von Mueller's description of a melastomaceous plant as a new genus (*Catanthera*) in Vaccinioideæ, one can derive nothing except a suggestion of parallel evolution.

Granting the connection of Ericaceæ to Dilleniaceæ, the ancestry of the family is traced back as far as that of any family of dicotyledons. The genus *Dillenia* is presumed to be a primitive group, close to *Magnolia* and of about the same evolutionary stage as *Alisma.* The more or less continuous evolutionary series from *Dillenia* to *Actinidia, Saurauia,* and *Clematoclethra*

[29] Vegetable Kingdom (1846) 423.
[30] Pl. Ind. Bot. Or. (1856) 34.

covers a range of evolutionary stages much broader than the gap between the latter genera and the Ericales.

ERICACEÆ OF THE MALAY REGION: GEOGRAPHIC AND HISTORICAL SUMMARY

Ericaceæ inhabiting the Malay region were first described by W. Jack, who, in 1822, published his Malay Miscellany, in Bencoelen, a region of southwestern Sumatra. I have not seen this work, which is apparently very rare; three articles by Jack in Hooker's Botanical Miscellany and Journal of Botany are reprinted from it. Here two species of Ericaceæ are described:[31] *Rhododendron malayanum* and *Vaccinium sumatranum*. These were collected "on the very summit of Gunong Bunko, a remarkably insulated mountain in the interior of Bencoolen, commonly called by Europeans the Sugar-loaf, in reference to its shape. Its elevation is estimated not to exceed three thousand feet . . ." *Rhododendron malayanum* is a widely distributed and well known species; on the other hand, I have found no reference to any subsequent collection of *Vaccinium sumatranum:* this name will probably be found to replace one now more familiar.

In 1826, Blume, in his Bijdragen, treated the Ericaceæ, chiefly of Java and Celebes. He described twenty-one species, including representatives of all of the three subfamilies in which the Ericaceæ of the Malay region are now included. He included all of the native Rhododendroideæ (that is, all those described in the Bijdragen, with the exception of several cultivated species from China and Japan) in a new genus, *Vireya;* three of his six Arbutoideæ in a new genus, *Diplycosia;* and all except two of his Vaccinioideæ in *Thibaudia*, a genus otherwise reported only from South America.

From support of the proposition that most of the Ericaceæ of the Malay region belong to genera unknown in Europe and Asia, Blume began to retire in his Flora Javæ, where, in a footnote,[32] he reduced *Vireya* to *Azalea* and *Rhododendron*, but did not make the new combinations. These were made by Hasskarl,[33] who also transferred all of Blume's *Diplycosiæ* to *Gaultheria*. Hasskarl, and Miquel,[34] the next great worker in the

[31] Hooker's Journ. Bot. 1 (1834) 369.

[32] 1 (1828) introd. vii.

[33] Cat. Pl. Bog. (1844) 160–162.

[34] Fl. Ind. Bot. 2 (1858–9) 1053 et seq. Ann. Mus. Bot. Lugd. Bat. 1 (1863) 36 et seq.

field of botany in the Malay region, described a few new species; thirty-one were listed in Miquel's final work. Since 1863, changes in the list of Ericaceæ known from Java, Celebes, Sumatra, and Dutch Borneo have been few and incidental. In 1914 the Ericaceæ of Java were revised by J. J. Smith,[35] who recognized twenty-three species on this island; and in 1925 a contribution by Hochreutiner [36] appeared. It is apparent from these works that several taxonomic problems, with regard to the Ericaceæ of Java, remain to be solved. The most important changes since 1863 have been the restoration of the genus *Diplycosia* and the description of *Costera.*

As early as 1848, Lindley [37] described four species of *Rhododendron* collected by Low in Sarawak. A few years later, after the first visit of white men to Mount Kinabalu, the younger Hooker was roused to such expressions of surprise as the following:

> Mr. Low's discovery of thirteen species of *Rhododendron,* during an ascent of only 8,000 feet on a mountain that rises to 14,000, is a most remarkable and interesting fact to the botanist and horticulturist. Till within a few years this genus had been thought almost peculiar to temperate and cold climates, an error first disproved by Mr. Low [overlooking Jack and Blume], and exposed by Dr. Lindley in the Hort. Soc. Journal, vol. iii, p. 82, where Bornean species are figured from under the equator itself, and growing at the level of the sea.[38]
>
> When we first received *Rhododendrons* from Borneo, we regarded the island whence they came as partaking, in respect of this genus, the characteristics of the north temperate zone; but now that species not only multiply in extraordinary profusion, but are found to frequent all elevations and all localities from the sea-coast inland, we are bound to reverse this, and consider that the Malay Archipelago is the head-quarters of the genus, and all other species outlying ones.[39]

The subsequent explorations of Haviland, as well as of more recent travellers, have increased but slightly the number of *Rhododendra* known from British North Borneo; they have, however, revealed the presence on Mount Kinabalu of fourteen species of *Diplycosia,* about one-third of the total number in the genus, as well as of a good representation of *Vaccinium.* Beccari and more recent explorers have added greatly to the number of Ericaceæ known from Sarawak.

[35] In Meded. Dept. Landbouw 18 (1814) 88–189.
[36] In Candollea 2 (1925) 490–502.
[37] Journ. Hort. Soc. Lond. 3 (1848) 81–91.
[38] Ic. Pl. (1852) t. 883.
[39] Op. cit. t. 890.

From the Malay Peninsula, eight scattered species were included by Clarke in Hooker's Flora of British India (1882). King and Gamble (1905), and Ridley, in a long series of papers, have added greatly to the list.

The history of our knowledge of Philippine Ericaceæ is discussed in connection with the various genera there occurring. Most of the Ericaceæ known from these islands before the American occupation were described by Sebastian Vidal. Most of the great increase beginning in 1905 is due to the work of Merrill, although one should not fail to mention the contributions of Warburg (1905) and Elmer (1911). The Philippine Ericaceæ are not now well known in comparison with the representatives of any important family of seed plants in any part of Europe or the United States. Nevertheless, the flora of the Philippines, as of Java and of the Malay Peninsula, is well known for an Oriental, tropical country.

This is not equally true of northern Borneo. Our knowledge of the Ericaceæ of Dutch Borneo, Sumatra, Celebes, and the Moluccas is very fragmentary.

The earliest account of the highland flora of British New Guinea was published by von Mueller [40] in 1889. Twelve Ericaceæ were described. Ten years later, Wright,[41] described four more; there has been only a slight scattering of other contributions.

The flora of northeastern (formerly German) New Guinea has been extensively studied. Ericaceæ were first described by Warburg,[42] who introduced four new *Rhododendra*. Schumann and Lauterbach (1901) added a few species. In 1917 and 1918, Schlechter [43] published no less than forty-seven new species, a greater number than had previously been known. His paper is a valuable contribution to classification, as well as to phytography.

Ericaceæ were first reported from Dutch New Guinea by Beccari (1878). None were added until 1909, when Koorders described a few. In the next decade a truly surprising number of species were distinguished; mostly by J. J. Smith, who published on this family in several fascicles of Nova Guinea; also by Wernham.[44] Nevertheless, the Ericaceæ of Dutch New Guinea

[40] Trans. Roy. Soc. Vict. 1, part 2.
[41] Kew Bull. (1899) 102–104.
[42] Engler's Bot. Jahrb. 16 (1893) 24–27.
[43] Engler's Bot. Jahrb. 55 (1917) 137–144, (1918) 145–194.
[44] Trans. Linn. Soc. Bot. 9 (1916) 89–100.

cannot be regarded as well known, since, according to the published records, a large majority of the species are known only by single collections.

Ericaceæ are poorly represented in Australia. This continent is mentioned because three species in Queensland are evidently outposts of the vegetation of New Guinea. A *Gaultheria* in Victoria belongs to the Antarctic flora. *Wittsteinia,* with a single species in Victoria, remains, as when von Mueller first described it, a genus incertæ sedis.

Ericaceæ are represented on the scattered islands of the Pacific by *Paphia,* which, although first described from Fiji, must be regarded as primarily a New Guinean genus; and by a number of species of *Vaccinium,* all of which are assigned to a single section, *Macropelma.* The relationships of *Macropelma,* whether with plants of the west, south, or east, remain very doubtful.

THE GENERA OF MALAYAN ERICACEÆ

The following is a key to the ericaceous genera recognized in the regions just discussed.

1. Ovary superior; disk surrounding the base of the ovary.
   2. Fruit not a septicidal capsule (subfamily Rhododendroideæ). 1. *Rhododendron.*
   2. Fruit not a septicidal capsule (subfamily Arbutoideæ).
      3. Fruit proper not a berry.
         4. Fruit a loculicidal capsule, not inclosed in the calyx; bracteoles absent; appendages present at the summits of the filaments, absent on the anthers ..... 2. *Xolisma.*
         4. Fruit inclosed in the accrescent calyx; calyx usually subtended by two bracteoles.
            5. Fruit a loculicidal capsule; flowers often in racemes; almost always with four terminal horns on each anther. 3. *Gaultheria.*
            5. Fruit an irregularly shattering capsule; flowers axillary, solitary or fascicled; each anther with two terminal appendages or none ..... 4. *Diplycosia.*
      3. Fruit proper a berry; calyx subtended by two or three bracteoles; anthers with two long tubes ..... 5. *Pernettyopsis.*
1. Ovary more or less inferior (subfamily Vaccinioideæ).
   2. Disk massive, belting the ovary, which is at least half superior. 6. *Disiphon.*
   2. Disk crowning the ovary, which is usually fully inferior.
      3. Anthers dehiscing by terminal pores.
         4. Ovary attenuate into the pedicel, with no visible articulation; flowers minute.
            5. Stamens ten; petals united ..... 7. *Iaera.*
            5. Stamens five; petals separate ..... 8. *Costera.*

4. Ovary definitely articulated to the pedicel.
   5. Flowers under 1 cm long, or if longer, in racemes in which the rhachis is much longer than the pedicels and not much stouter. 9. *Vaccinium.*
   5. Flowers over 1 cm long (occasionally slightly shorter), solitary, fascicled, or in short racemes in which the rhachis is not much longer but is much stouter than the pedicels.
      6. Anthers all alike.
         7. Ovary without five conspicuous lengthwise wings.
            8. Plants of the region west of Java ..... 10. *Agapetes.*
            8. Plants of the region east of Celebes ..... 11. *Paphia.*
         7. Ovary with five conspicuous lengthwise wings. 12. *Pentapterygium.*
      6. Anthers of two kinds, five large ones alternating with five small ones ..... 13. *Dimorphanthera.*
3. Anthers dehiscing by longitudinal slits ..... 14. *Wittsteinia.*

Rhododendron Linn., Sp. Pl. (1753) 329. Type, *R. ferrugineum* Linn., of the Alps. Of the very numerous species, about half are native in western China, where the individuals appear to vary as do individuals of *Crataegus* in northeastern North America. In the Malay region, there are known more representatives of this genus than of any other in the family. The conspicuous flowers attract collectors who might overlook a *Vaccinium* or *Diplycosia,* and *Rhododendron* is accordingly more nearly completely known than the other genera. A number of subgenera are recognized.

A. The subgenus *Eurhododendron* includes all except about one hundred of the species. It is divided into three sections:

1. *Leiorhodion* Rehder. Leaves not scaly. This section includes a great many species in central Asia, and probably a clear majority of the species of the genus. It is represented in the Malay region only by a single species, *R. moulmainense,* in the western extremity of the region, the Malay Peninsula.

2. *Lepipherum* G. Don. Leaves scaly; ovary scaly; bud scales white ciliate. This is the type section; the species are distributed through Europe, Asia, and North America. There are many species in the Malay Region.

3. *Vireya.* Leaves moderately scaly; ovary not densely scaly, often pubescent; bud scales not white ciliate. This section, of which the type is *R. javanicum,* is confined to the Malay region, and includes most of the species of that region. Schlechter arranged the New Guinean species of *Rhododendron* in "sections;" most of these groups should be regarded as subsections of *Vireya.*

Recently,[45] in ignorance of Schlechter's work, I described a number of subsections of *Vireya*, of some of which the names will have to be replaced by those of Schlechter. The necessary changing of subsectional names will not be a perfectly simple matter, because some of the groups described by Schlechter are probably not represented in the Philippines, while others appear not to be natural, including species of *Lepipherum* as well as of *Vireya*.

B. The subgenus *Anthodendron* (commonly called *Azalea*) includes nearly one hundred species of eastern Asia and of North America. It is represented in the Malay region only in the northernmost extension of that region, in northern Luzon, and only by a single species, *R. subsessile*.

There are several other subgenera, each of only a few species, and not represented in the Malay region.

Xolisma Rafinesque in Am. Month. Mag. 4 (1819) 193. This genus, long neglected, was restored by Britton as a segregate from *Andromeda* or *Pieris*, from which it is distinguished by thickened capsule-sutures, by lack of appendages on the anthers, and in many species by the presence of appendages at the summits of the filaments. Rehder[46] has made the combination *Xolisma ovalifolia* (Wallich), for a species which, with many varieties, extends from the Himalayas to Japan and Formosa, and enters the westernmost extension of the Malay region in the Malay Peninsula. The species had previously been included in *Andromeda, Lyonia*, and *Pieris*, most persistently in the last. Rehder makes it the type of a section *Pieridopsis*.

Gaultheria [Kalm] Linn., Sp. Pl. (1753) 395, and *Diplycosia* Blume Bijdr. (1826) 857, are fully discussed in connection with their Philippine representatives.

Pernettyopsis King and Gamble in Journ. As. Soc. Beng. 74:2 (1905) 79. Three species confined to the Malay Peninsula.

Disiphon Schlechter in Engler's Bot. Jahrb. 55 (1918) 166. A single species in northeastern New Guinea, an epiphyte at moderate elevations, known by a single collection. Lacking fruit, Schlechter could not assign it with confidence to any tribe or subfamily. The leaves are large, lance-acuminate; the flowers, few in lax racemes, have barrel-shaped corollas about 15 mm long.

[45] Philip. Journ. Sci. 40 (1929) 133–179.

[46] Journ. Arn. Arb. 5 (1924) 52.

Iaera may be compared with *Costera* J. J. Smith in Ic. Bogor. 4 (1910) t. 324, with a single species, *C. ovalifolia,* on the islands Karimata and Madjang, west of Borneo, where it seems to have been collected only by Teysmann. Mention of *Iaera* and *Costera* involves a discussion of the classification of the subfamily Vaccinioideæ. Bentham and Hooker established two tribes, Vaccinieæ (they wrote *Euvaccinieæ*), chiefly in the northern hemisphere, with comparatively small flowers, the filaments separate and fairly long as compared with the anthers; and Thibaudieæ, chiefly in South America, with large flowers, the filaments usually shorter than the anthers, contiguous or connate. Drude maintained the same tribes; he omitted mention of flower size in the descriptions, but added another distinction, that in Vaccinieæ "Frkn. vom Blütenstiel scharf abgesetzt und oft abgegliedert," while in Thibaudieæ, "Kelch am Frkn. herablaufend und im Blütenstiel übergehend (selten abgegliedert)." Now in *Iaera* and *Costera* the flowers are minute, and the filaments are as distinct as in any species of *Vaccinium;* on the other hand, these alone among the known Vaccinioideæ of the Malay region have no articulation between the pedicel and the ovary. They are excluded by the accepted definition of either tribe, and may safely be recognized as genera, while their relationships remain in doubt. The distinctive characters of *Costera* (the separate petals and five stamens) probably mark a less primitive genus than *Iaera,* although the latter occurs farther from the continent of Asia.

Vaccinium Linn., Sp. Pl. (1753) 349. I have already [47] discussed this genus, to which many species of the Malay region have been assigned, in connection with the Philippine species, but cannot refrain from further comment. The present situation is much as in 1852, when the elder Hooker remarked:[48]

> While the recent labours of Dr. Wight on the Vacciniaceous plants of India have induced him to refer all known to him (including the genera *Agapetes, Ceratostemma,* and *Thibaudia* of Authors) to the true *Vaccinium,* Dr. Klotzsch's investigations of the *entire* family have led him to the opinion that the genera require to be multiplied, so that we find in the "Linnaea", vol. xxiv. (for 1851), no less than fourteen new genera added, and the previously existing ones thus increased to twenty-eight!

In the course of their attempt to get rid of such situations, the authors of the Genera *Plantarum* recognized the following as Vacciniaceous genera occurring in the East Indies: *Vac-*

[47] Philip. Journ. Sci. 42 (1930) 537–607.
[48] Bot. Mag. t. 4688.

cinium (subgenus *Epigynium*), *Agapetes, Pentapterygium, Rigiolepis,* and the new *Corallobotrys.* Drude, in the Natürlichen Pflanzenfamilien, made only a single insignificant change in the list. This treatment scarcely represents a real understanding of the group. The difficulties in the way of attaining such understanding become more evident from time to time, as species peculiar in one way or another are discovered. No well considered arrangement is here offered, but only the following list of groups currently included in *Vaccinium,* for each of which there are to be discovered distinctive characters (or the lack of them), definite lists of species, and relationships:

1. *Epigynium* proper; plants of the mainland of Asia, with serrate leaves, including *V. serratum, V. leschenaultii. V. neilgherrense,* and *V. donianum. Vaccinium malaccense* probably does not belong with these.

2. *Vaccinium dunalianum,* and a number of related species with entire leaves, such as *V. petelotii,*[49] *V. poilanei,* and others recently described by M. Dop. These also are confined to the continent of Asia.

3. *Nesococcus,* proposed by myself, to include most of the species of the Malay region, excepting New Guinea: ovary ten-celled, with many seeds in one column in each cell; flowers usually in racemes. This group includes most of the *species non satis notae* assigned to *Epigynium* in the original description of that group, as a genus, by Klotzsch.

4. *Galeopetalum* J. J. Smith,[50] with a single species, *V. dialypetalum,* from Java. This appears to differ from *Nesococcus* only in having separate petals, which is probably a derived character.

5. *Vaccinium uniflorum* J. J. Smith and *V. monanthum* Ridley are known each by a single collection from Borneo; they are characterized by minute solitary flowers.

6. *Rigiolepis* (Hooker f.). This group, described as having only ten seeds in the fruit, is represented in Java and Borneo. It has now been treated as a separate genus, and now reduced

[49] *Vaccinium petelotii* Merrill in Univ. Calif. Publ. Bot. 13 (1926) 138 is represented by *Petelot 1772* and *3.115,* collected at Chapa in Indo-China. In view of the existence of this name, I propose *Vaccinium dopii* nom. nov. (*V. petelotii* Dop in Fl. Gen. Indo-Chine 3:6 (1930) 703) for a different species collected by the same explorer at the same locality. Merrill's species appears to be different from all the new species described by Dop.

[50] Ic. Bogor. 4 (1912) 101.

to *Vaccinium;* it has most recently been restored by Ridley [51], who remarks that "By some curious error Merrill has reduced *Rigiolepis borneensis* [the type] to *Vaccinium acuminatissimum,* Miq., with which it has nothing in common. W. W. Smith described it as *Vaccinium borneense,* without recognizing it as the original *Rigiolepis borneensis.*" It should be noticed that it was not Merrill but Boerlage [52] who reduced *Rigiolepis borneensis,* with an extensive discussion including the statement that "de afbeelding toch in HOOKER'S Icones t. 1160 bewijst dat *R. Borneensis Hook. f.* een vorm is van *V. acuminatissimum Miq.* en zelfs identik met MIQUEL'S *forma Borneensis* dezer soort. De eierstok is daar evenals bij andere *Vaccinium*-soorten door valsche tusschenschotten 10-hokkig en elk hokje bevat 1–2 of meer eitjes. Ook *V. leptanthum Miq.* moet als een vorm dezer soort beschouwd worden." We have here the statement that *Vaccinium acuminatissimum* (significantly included by Blume in *Gaylussaccia*) has a spuriously ten-celled ovary with *one, two, or more* ovules in each cavity; that *V. leptanthum* shows the same character; and that *Rigiolepis borneensis* is *Vaccinium acuminatissimum* forma *borneense* Miq. All this is not inconsistent with the possibility that *Rigiolepis* should be restored as a genus and *R. borneensis* as a species: but at least, neither the genus nor the species is far removed from others.

7. *Oarianthe* Schlechter; a group of small-leaved species with solitary flowers and five-celled ovaries, numerous in New Guinea. The assignment to this group of *V. microphyllum* Miq., of the Moluccas, Celebes, and the Philippines, is tentative.

8. *Neojunghuhnia* (Koorders), numerous in New Guinea, with racemose flowers and five-celled ovaries. The Bornean *V. cordifolium* Stapf is tentatively assigned to this group. Koorders recognized the presence of *Vaccinium* in New Guinea, but was confused by an immature specimen, on the basis of which he described *Neojunghuhnia* [53] as a remarkable new genus. His error was corrected by J. J. Smith,[54] but Koorders' name remains as the oldest for the group.

9. *Macropelma* Klotzsch. Type, *V. cereum.* The Polynesian group, of which thirteen species have been described; some of which, however, are very doubtful. The flowers are axillary on

[51] Kew Bull. (1922) 106–108.
[52] Handl. Fl. Nederl. Ind. 2 (1891) 263.
[53] Nova Guinea 8 (1909) 183.
[54] Meded. Rijks Herb. Leiden 25 (1915) 13.

rather long pedicels. Skottsberg [55] discusses the systematic position of this group; he suggests, not very confidently, a connection with the boreal section *Myrtillus*, the type section of the genus. The possibility that *Macropelma* is closest to *Neojunghuhnia* or *Oariantha* should be investigated.

Probably most or all of these groups will eventually be removed from *Vaccinium*, with the establishment of several genera.

Agapetes G. Don, Gen. Syst. 3 (1834) 862. I have quoted above, at second hand, Wight's opinion on the status of this genus. The group is so close to the representatives of *Vaccinium* in the same region, that one can hardly accept the action of Bentham and Hooker, and of Drude, in referring it to the Thibaudieæ. The type is *A. setigera;* this and several of the other species have notably large flowers, and notably short, laterally contiguous stamens. These probably constitute a tenable genus. Only four species enter the Malay region, in its western extremity, the Malay Peninsula; these have flowers no larger than many species of *Vaccinium*. Ridley distinguishes them from the *Vaccinia* of the Malay Peninsula by the shape of the corolla, a character whose value in distinguishing genera is questionable.

Paphia Seeman in Journ. Bot. 2 (1864) 77. Type, *P. vitiensis*, of Fiji. This genus was reduced to *Agapetes* by Bentham and Hooker, and was restored by Drude. Schlechter added four species; he described two from northeastern New Guinea, and transferred *Vaccinium helenae* F. v. M., of British New Guinea, and *Agapetes meiniana* F. v. M., of Queensland. If the genus is tenable, *A. queenslandica* Domin should probably be transferred to it. I am not aware of any characters separating *Paphia* from *Agapetes*, but the geographic gap between New Guinea and India leads me to expect that differences will be detected.

Pentapterygium Klotzsch in Linnæa 24 (1851) 47. Type, *P. serpens*. A small group, in eastern Asia; very close to *Agapetes*, but definitely distinguishable by the winged calyx.

Dimorphanthera F. v. M. in Wing's Southern Science Record n. s. 2 (1886). Type, *D. moorhousiana*. This fairly large genus, mostly New Guinean, is closely related to the three preceding, but is very definitely distinguishable by the dimorphous anthers from which the name is taken. I discuss the group more fully in connection with the Philippine species.

Wittsteinia F. v. M. in Frag. Phyt. Austr. 2 (1861) 136. The single species, from Victoria, has very much the aspect of the

[55] Bishop Mus. Bull. 43 (1927) 87.

Vaccinia of section *Macropelma;* but the anthers are not of the type characteristic of the family.

The numbers of species known in the various genera just discussed are shown in Table 1.

TABLE 1.—*Distribution of species in the various genera of Ericaceæ.*

Genus.	Malay Peninsula.	Sumatra.	Java.	Borneo.			Philippine Islands.	Celebes.
				Dutch.	Sarawak.	British North.		
Rhododendron	19	9	9	7	19	14	21	5
Xolisma	1							
Gaultheria	3	4	3			1	3	1
Diplycosia	6	3	3	1	5	14	8	2
Pernettyopsis	3							
Disiphon								
Iaera							3	
Costera				1				
Vaccinium	17	16	13	6	12	9	29	7
Agapetes	4							
Paphia								
Pentapterygium	1							
Dimorphanthera							2	
Wittsteinia								
Total	54	32	28	15	36	38	66	15

Genus.	Moluccas etc.	New Guinea.			Australia.	Pacific Islands.	Total.	
		Dutch.	British.	Northeast.			Malay Region.	World.
Rhododendron		58	14	29	1		181	850
Xolisma							1	31
Gaultheria		5	1		1		15	130
Diplycosia	[a] 2	4		4			41	41
Pernettyopsis							3	3
Disiphon				1			1	1
Iaera							3	3
Costera							1	1
Vaccinium	[b] 3	48	6	17		[d] 10	166	370
Agapetes							4	48
Paphia			1	2	2	1	6	6
Pentapterygium							1	7
Dimorphanthera	[c] 1	17	3	10			32	32
Wittsteinia					1		1	1
Total	6	132	25	63	5	11	455	1,524

[a] One in Amboyna, one in Lombok.

[b] Two in Tidor and Ternate; one in Timor.

[c] One in Amboyna.

[d] Six in Hawaii, fide Skottsberg in Bishop Mus. Bull. 43 (1927) 65–87; one in Tahiti and the Marquesas, two in Samoa, and one in the New Hebrides.

EXCLUDED GENERA

Catanthera F. v. M. in Journ. Bot. 24 (1886) 289. A single species, *C. lysipetala,* was described to include *Forbes 419* and *451,* from British New Guinea. This name, long an ornament to lists of *genera incertæ sedis,* was shown by Schlechter [56] to belong to some Melastomaceous plant.

Mischopleura Wernham in Hooker's Ic. Pl. (1916) t. 3059. Two species, based on plants collected by the Wollaston Expedition to Dutch New Guinea, were described. On studying the generic description, I could scarcely believe that these plants belong to Ericaceæ. *Mischopleura* appears to differ from *Hibbertia* only in having one style instead of two or more, and may confidently be assigned to the Dilleniaceæ.

ACKNOWLEDGMENTS

Work toward the taxonomic revision of the Philippine Ericaceæ which I here conclude was undertaken in 1927, at the University of California; at the suggestion, and under the guidance, of Dr. E. D. Merrill. For the purpose of this work, Doctor Merrill secured loans of the material of Philippine and Malayan Ericaceæ in the herbarium of the Bureau of Science at Manila, and in the United States National Herbarium. I must acknowledge a very great obligation to the authorities in charge of these respective herbaria. I have also had access to the herbarium of the University of California, and to the Dudley Herbarium of Stanford University.

When Doctor Merrill was called to the directorship of the New York Botanic Garden in January, 1930, Dr. L. R. Abrams of Stanford University undertook the supervision of the remainder of my work. Among those who have steadily helped me in every way possible, I must mention, with Doctor Merrill and Doctor Abrams, my father, Dr. E. B. Copeland. It is my earnest hope that my work may be found worthy of the standing, as botanists and as teachers, of these gentlemen.

The completion of this work was facilitated by Stanford University, which granted me a University Fellowship for three quarters.

BIBLIOGRAPHY

1. Bailey F. M. In Queensland Dept. Agr. Report of the Government Scientific Expedition to the Bellenden-Ker Range (1889) 47.

[56] Engler's Bot. Jahrb. 55 (1918) 193.

2. Bailey, F. M. Contributions to the Queensland flora. Queensland Dept. Agr. Brisbane Bot. Bull. 10 (1895) 21–43 (non vidi).
3. Beccari, O. Malesia 1 (1878) 199–213.
4. Beccari, O. Nelle foreste di Borneo (1902) 147 (non vidi).
5. Bennett, J. J., and R. Brown. Plantae javanicae rariores, descriptae iconibusque illustratae, quas in insula Java, annis 1802–1818, legit et investigavit Thomas Horsfield M. D. (1838–1852) 85–89, t. 19, 20.
6. Bentham, G., and J. D. Hooker. Genera Plantarum 2 (1876) 564–604.
7. Blume, C. L. Catalogus van eenige der merkwaardigste zoo in- als uit-heemsche gewassen, te vinden in 's lands Plantentuin te Buitenzorg (1823) (non vidi).
8. Blume, C. L. Bijdragen tot de flora van Nederlandsch Indië 15 (1826) 851–863.
9. Blume, C. L. Flora Javae 1 (1826) vii-viii.
10. Boerlage, J. G. In P. J. Veth. Midden-Sumatra 4:2 (1884) 22.
11. Boerlage, J. G. Handleiding tot de kennis der flora van Nederlandsch Indië 2 (1891) 259–271.
12. Breitfeld, A. Der anatomische Bau der Blätter der Rhododendroideae Engler's Bot. Jahrb. 9 (1888) 319–379, t. 5, 6.
13. Brown, W. H. Vegetation of Philippine mountains (1919) 99, 393, 412, t. 23, 24.
14. Burbridge, O. The Gardens of the Sun (1880) 274–275.
15. Burkill, I. H., and M. R. Henderson. The flowering plants of Taiping, in the Malay Peninsula. Gard. Bull. Straits Settlements 3 (1925) 303–458.
16. Burkill, I. H., and R. E. Holttum. A botanical reconnaissance upon the main range of the Peninsula at Fraser Hill. Gard. Bull. Straits Settlements 3 (1923) 19–110.
17. de Candolle, A. P. Prodromus systematis naturalis regni vegetabilis 7 (1839) 580–733.
18. Ceron, S. Catálogo de los plantas del herbario recolectado por el personal de la suprimida comisión de la flora forestal (1892) (non vidi).
19. Clarke, C. B., in J. D. Hooker. Flora of Bristish India 3 (1882) 442–476.
20. Copeland, H. F. Philippine Ericaceae, I: The species of Rhododendron. Philip. Journ. Sci. 40 (1929) 133–179, t. 1–16.
21. Copeland, H. F. Philippine Ericaceæ, II: The species of Vaccinium. Philip. Journ. Sci. 42 (1930) 537–607, t. 1–7.
22. Domin, K. Seventh contribution to the flora of Queensland. Fedde Repert. 12 (1913) 130–133.
23. Don, D. Prodromus florae nepalensis (1825) (non vidi).
24. Don, G. A general system of gardening and botany 3 (1834) 785–867.
25. Dop, P. In Flore génerale de l'Indo-Chine 3 (1930) 698–746.
26. Drake del Castillo, E. Flore de la Polynesie francaise (1893) 114–115.
27. Drude, O. In A. Engler and K. Prantl. Die Natürlichen Pflanzenfamilien 4:1 (1891) 15–65.
28. Dunal, F. In A. P. de Candolle. Prodromus systematis naturalis regni vegetabilis 7 (1839) 552–579.

29. Elmer, A. D. E. The Ericaceæ of Mount Apo. Leafl. Philip. Bot. 3 (1911) 1089–1107.
30. Elmer, A. D. E. Two score of new plants. Leafl. Philip. Bot. 4 (1912) 1475–1520.
31. Elmer, A. D. E. Two hundred twenty-six new species, I. Leafl. Philip. Bot. 7 (1915) 2543–2700.
32. Endlicher, S. Genera plantarum secundum ordines naturales disposita (1836–1840) 750–761.
33. Fawcett, W. In H. O. Forbes. A naturalist's wanderings in the eastern archipelago (1885) 278–279, 509.
34. Fawcett, W. Vaccinium Forbesii. Journ. of Bot. 23 (1885) 254.
35. Forbes, F. B., and W. B. Hemsley. An enumeration of all the plants known from China . . . . Journ. Linn. Soc. (1886–1905) (Ericaceæ, op. cit. 26 (1889) 15–34, reprinted as vol. 2, pp. 15–34).
36. Förster-Bretten, F. Neue Alpenrosen aus Kaiser-Wilhelms-Land. Fedde Repert. 13 (1914) 221–225.
37. Gibbs, L. S. A contribution to the flora and plant formations of Mount Kinabalu and the highlands of British North Borneo. Journ. Linn. Soc. Bot. 42 (1914) 1–240, t. 1–8.
38. Gray, A. Characters of new or obscure species of plants of monopetalous orders in the collection of the United States South Pacific Exploring Expedition under Captain Wilkes . . . . Proc. Am. Acad. 5 (1861) 321–352.
39. Hasskarl, J. K. Catalogus plantarum in Horto Botanico Bogoriensi cultarum alter . . . . (Tweede catalogus der in's Lands Plantentuin te Buitenzorg gekweekte gewassen . . . .) (1844) 160–162.
40. Hayata, B. Flora montana Formosae. Journ. Coll. Sci. Tokyo 25 art. 19 (1908) 1–260, t. 1–41.
41. Hayata, B. Materials for a flora of Formosa. Journ. Coll. Sci. Tokyo 30 art. 1 (1911) 1–471.
42. Hayata, B. Icones plantarum formosanarum . . . . 2 (1912) 115–120, f. 1–9, t. 11–16; 3 (1913) 125–145, t. 22–26; 4 (1914) 15–17; 5 (1915) 84.
43. Hemsley, W. B. In Curtis's Botanical Magazine (1911) t. 8372.
44. Henderson, M. R. Additions to the list of Fraser Hill plants. Gard. Bull. Straits Settlements 4 (1927) 92–105.
45. Henderson, M. R. The flowering plants of Kuala Lumpur, in the Malay Peninsula. Gard. Bull. Straits Settlements 4 (1928) 211–373.
46. Hochreutiner, B. P. G. Plantæ Hochreutineranæ. Candollea 2 (1925) 317–513.
47. Holttum, R. E. The vegetation of Gunong Belumut in Johore. Gard. Bull. Straits Settlements 3 (1924) 245–257.
48. Hooker, J. D. In Icones plantarum (1852) t. 883–894); (1876) t. 1160.
49. Hooker, J. D. In Curtis's Botanical Magazine (1872) t. 5984; (1873) t. 6045; (1884) t. 6769; (1885) t. 6850.
50. Hooker, W. J. In Icones plantarum (1836) t. 87; (1840) t. 246; (1848) t. 740.
51. Hooker, W. J., in Curtis's Botanical Magazine (1847) t. 4336; (1850) t. 4524; (1851) t. 4612; (1852) t. 4688; (1854) t. 4797; (1855) t. 4859; (1856) t. 4904, 4935; (1857) t. 4972.

52. JACK, WILLIAM. Description of Malayan plants. Hooker's Journ. Bot. 1 (1834) 358–380 (reprinted from Jack Mal. Misc. (1822; non vidi)).

53. JUNGHUHN, F. Topographische und naturwissenschaftliche Reisen durch Java . . . . (1845) 451 (non vidi. Review by "K. M." in Bot. Zeit 3 (1845); and by J. K. Hasskarl in Flora 5 (1847)).

54. JUNGHUHN, F. Diagnoses et adumbrationes stirpium nonnullarum novarum vel non satis cognitarum florae javanicae alpinae indiginarum. Nat. en Geneesk. Arch 2 (1845) 20–54 (non vidi. Apparently a collection of diagnoses from the preceding).

55. JUNGHUHN, F. Java dezelfs gedaante, bekleeding en inwendige structuur (1850–1854) (non vidi. German translation by J. K. Hasskarl, second edition 1 (1857) 419–421).

56. KING, G., and J. S. GAMBLE. Materials for a flora of the Malay Peninsula. Journ. As. Soc. Beng. (1889–1909) (Ericaceæ, op. cit. 74:2 (1905) 58–80; reprinted as vol. 4, pp. 268–290).

57. KLOTZSCH, J. F. Studien über die natürliche Klasse Bicornes Linné. Linnaea 24 (1851) 1–88.

58. KOORDERS, S. H. Verslag eener botanische dienstreis door de Minahasatevens eerste overzicht der flora van N. O. Celebes . . . . Meded. Lands Plant. 19 (1898) (Ericaceæ, pp. 513–515).

59. KOORDERS, S. H. Hochgebirgs Flora von Tosari. Natuurkundige Tijdschrift van Nederl. Ind. 60 (1900) (non vidi).

60. KOORDERS, S. H. Ericaceæ. Nova Guinea 8 (1909) 183–192, t. 48.

61. KOORDERS, S. H. Ericaceæ. Nova Guinea 8 (1912) 875–887, t. 150–157.

62. KOORDERS, S. H. Exkursionsflora von Java 3 (1912) 2–19.

63. KOORDERS-SCHUMACHER, A. Systematisches Verzeichnis der zum Herbar Koorders gehörenden, in Niederländisch-Ostindien, besonders in den Jahren 1888–1903 gesammelten Phanerogamen und Pteridophyten . . . . (1910–1914) (Ericaceæ, I Abt., Fam. 233, pp. 106–112; Nachtr., p. 15; III Abt., p. 100).

64. KUNTZE, O. Revisio generum plantarum 2 (1891) 382–391; 3:2 (1898) 190–193.

65. KURZ, S. On a few plants from Yunan. Journ. of Bot. 11 (1873) 193–196.

66. LEMAIRE, CH., and L. VAN HOUTTE. Rhododendron javanicum, rosage de Java. Flore des Serres 3 (1847) 293–294 and 293–294b.

67. LINDLEY, J. A notice on some species of Rhododendron inhabiting Borneo. Journ. Hort. Soc. London 3 (1848) 81–91.

68. LINDLEY, J., and J. PAXTON. In Paxton's Flower Garden 1 (1850–1851) 95–96; 2 (1851–1852) 164, 181.

69. MERRILL, E. D. New or noteworthy Philippine plants, III. Govt. Lab. Publ. (Philip.) 29 (1905) (Ericaceæ, pp. 39–44).

70. MERRILL, E. D. New or noteworthy Philippine plants, IV. Govt. Lab. Publ. (Philip.) 35 (1905) (Ericaceæ, p. 54).

71. MERRILL, E. D. The flora of the Lamao Forest Reserve. Philip. Journ. Sci. 1 (1906) Suppl. 1–141.

72. MERRILL, E. D. New or noteworthy Philippine plants, V. Philip. Journ. Sci. 1 (1906) Suppl. 169–264.

73. MERRILL, E. D. The flora of Mount Halcon, Mindoro. Philip. Journ. Sci. 2 (1907) Bot. 251–309.

74. MERRILL, E. D. New Philippine plants from the collections of Mary Strong Clemens, I. Philip. Journ. Sci. 3 (1908) Bot. 129–165.
75. MERRILL, E. D. New or noteworthy Philippine plants, VI. Philip. Journ. Sci. 3 (1908) Bot. 219–267.
76. MERRILL, E. D. Philippine Ericaceae. Philip. Journ. Sci. 3 (1908) Bot. 369–382.
77. MERRILL, E. D. New or noteworthy Philippine plants, VII. Philip. Journ. Sci. 4 (1909) Bot. 247–330.
78. MERRILL, E. D. New or noteworthy Philippine plants, VIII. Philip. Journ. Sci. 5 (1910) Bot. 167–257.
79. MERRILL, E. D. Sertulum bontocense: new or interesting plants collected in Bontoc Subprovince, Luzon, by Father Morice Vanoverbergh. Philip. Journ. Sci. 7 (1912) Bot. 71–107.
80. MERRILL, E. D. New or noteworthy Philippine plants, IX. Philip. Journ. Sci. 7 (1912) Bot. 259–357.
81. MERRILL, E. D. New or noteworthy Philippine plants, XI. Philip. Journ. Sci. 10 (1915) Bot. 1–84.
82. MERRILL, E. D. New plants from Sorsogon Province, Luzon. Philip. Journ. Sci. 11 (1916) Bot. 1–35.
83. MERRILL, E. D. New or noteworthy Philippine plants, XII. Philip. Journ. Sci. 12 (1917) Bot. 287–394.
84. MERRILL, E. D. Contributions to our knowledge of the flora of Borneo. Journ. Str. Br. Roy. As. Soc. 76 (1917) 75–117.
85. MERRILL, E. D. New or noteworthy Philippine plants, XV. Philip. Journ. Sci. 14 (1919) 365–457.
86. MERRILL, E. D. A bibliographic enumeration of Bornean plants. Journ. Str. Br. Roy. As. Soc. (1921) special number (Ericaceæ, pp. 460–467).
87. MERRILL, E. D. New or noteworthy Philippine plants, XVII. Philip. Journ. Sci. 20 (1922) 367–476.
88. MERRILL, E. D. An Enumeration of Philippine Flowering Plants 3 (1923) 243–252; 4 (1926) 253.
89. MERRILL, E. D. New or noteworthy Bornean plants, Part III. Journ. Mal. Br. Roy. As. Soc. 1 (1923) 22–45.
90. MERRILL, E. D. New species of Philippine plants collected by A. Loher. Philip. Journ. Sci. 27 (1925) 21–59.
91. MERRILL, E. D. New species of plants from Indo China II. Univ. Calif. Publ. Bot. 13 (1926) 127–143.
92. MERRILL, E. D. The flora of Banguey Island. Philip. Journ. Sci. 29 (1926) 341–427.
93. MERRILL, E. D. An enumeration of Hainan plants. Lingnan Sci. Journ. 5 (1927) 1–186 (non vidi).
94. MERRILL, E. D. Unrecorded plants for Kwantung Province. Lingnaam Agr. Rev. 4 (1927) 119–136.
95. MERRILL, E. D. A collection of plants from Sarawak. Sarawak Mus. Journ. 3 (1928) 513–557.
96. MERRILL, E. D., and M. L. MERRITT. The flora of Mount Pulog. Philip. Journ. Sci. 5 (1910) Bot. 287–401.
97. MILLAIS, J. G. Rhododendrons (1917).
98. MILLAIS, J. G. Rhododendrons and their various hybrids. Second series (1924).

99. MIQUEL, F. A. G. Flora van Nederlandsch Indië (Flora Indiae batavae) 2 (1858–1859) 1053–1063; Suppl. (1860–1861) 251, 585–588.

100. MIQUEL, F. A. G. Ericaceae archipelagi indici. Ann. Mus. Bot. Lugd. Bat. 1 (1863) 36–45, (1864) 220–221.

101. MOORE, S. In Dr. H. O. Forbes's New Guinea plants. Journ. of Bot. 61 (1923) Suppl. 28.

102. MOORE, S. In Dr. H. O. Forbes's Malayan plants. Journ. of Bot. 63 (1925) Suppl. 55–57.

103. MORITZI, A. Systematisches Verzeichniss der von H. Zollinger in den Jahren 1842–1844 auf Java gesammelten Pflanzen. (1845–1846) 42.

104. VON MUELLER, F. Fragmenta phytographiae Australiae 2 (1861) 136; 3 (1863) 166.

105. VON MUELLER, F. In Papers Roy. Soc. Tasmania (1875) 103 (non vidi).

106. VON MUELLER, F. Systematic census of Australian plants (1882) 105.

107. VON MUELLER, F. Record of a new Papuan Rhododendron. Victor. Natural. 1 (1884) 101–102.

108. VON MUELLER, F. Description of a new Papuan vacciniaceous plant. Wing's Southern Science Record n. s. 2 (1886) non vidi. (Reprint in Bot. Centralbl. 26 (1886) 163–164.)

109. VON MUELLER, F. New Vacciniaceae from New Guinea. Journ. of Bot. 24 (1886) 289–291.

110. VON MUELLER, F. Descriptions of new Australian plants. Victor. Natural. 3 (1887) 157–160.

111. VON MUELLER, F. Description of an hitherto unrecorded Rhododendron from New Guinea. Victor. Natural. 4 (1887) 110–112 (reprint in Bot. Centralbl. 33 (1888) 55).

112. VON MUELLER, F. Second systematic census of Australian plants (1889) 177.

113. VON MUELLER, F. Records of observations on Sir William MacGregor's highland plants from New Guinea. Trans. Roy. Soc. Vict. 1:2 (1889) 1–45 (review by Jännicke in Bot. Centralbl. Beih. 1 (1891) 319–320).

114. VON MUELLER, F. Descriptive notes on Papuan plants 9 (1890) 63 (non vidi. Review by Jännicke in Bot. Centralbl. Beih. 1 (1891) 319).

115. VON MUELLER, F. New Papuan plants. Journ. of Bot. 29 (1891) 176–178.

116. NAVES, A., and C. FERNANDEZ-VILLAR, in E. Blanco. Flora de Filipinas. Gran edición 4:3 (1880–1883) 121.

117. NIEDENZU, F. Über den anatomischen Bau der Laubblätter der Arbutoideae und Vaccinioideae. Engler's Bot. Jahrb. 11 (1890) 134–263, t. 3–6.

118. PLANCHON, J. E. Les Rhododendron de l'Inde continentale et insulaire. Flore des Serres 5 (1849) 473–476b and 477–480b to 477–480m.

119. REHDER, A. New species, varieties, and combinations from the herbarium and collections of the Arnold Arboretum. Journ. Arn. Arb. 5 (1924) 49–59.

120. REINECKE, F. Die Flora der Samoa-Inseln. Teil II: Siphonogamen. Engler's Bot. Jahrb. 25 (1898) 578–708.

121. RENDLE, A. B. New Philippine plants. Journ. of Bot. 34 (1896) 355–358.

122. RIDLEY, H. N. On the flora of the eastern coast of the Malay Peninsula. Trans. Linn. Soc. Bot. 3 (1893) 267–408, t. 61–66.

123 RIDLEY, H. N. Plants collected at Penrissen. Journ. Str. Br. Roy. As. Soc. 33 (1900) 22–24.

124. RIDLEY, H. N. In W. D. BARNES. A trip to Gunong Benom in Pahang. Journ. Str. Br. Roy. As. Soc. 39 (1903) 1–18.

125. RIDLEY, H. N. On a collection of plants made by H. C. Robinson and L. Wray from Gunong Tahan, Pahang. Journ. Linn. Soc. Bot. 38 (1908) 301–336.

126. RIDLEY, H. N. The flora of the Telôm and Batang Padang valleys. Journ. F. M. S. Mus. 4 (1909) 1–98.

127. RIDLEY, H. N. New and rare Malayan plants (Series VI). Journ. Str. Br. Roy. As. Soc. 61 (1912) 1–43.

128. RIDLEY, H. N. Some plants collected on Mr. Moulton's expedition to Batu Lawi. Journ. Str. Br. Roy. As. Soc. 63 (1912) 59–62.

129. RIDLEY, H. N. An expedition to Mount Menuang Gasing, Selangor. Journ. Linn. Soc. Bot. 41 (1913) 285–304 (reprinted in Journ. F. M. S. Mus. 6 (1915) 1–21.)

130. RIDLEY, H. N. On a collection of plants from Gunong Mengkuang Lebah, Selangor. Journ. F. M. S. Mus. 5 (1914) 28–50.

131. RIDLEY, H. N. Rhododendron Andersonii. Kew Bull. (1914) 209.

132. RIDLEY, H. N. Plants from Gunong Kerbau, Perak. Journ. F. M. S. Mus. 5 (1915) 43–62.

133. RIDLEY, H. N. The botany of Gunong Tahan, Pahang. Journ. F. M. S. Mus. 6 (1915) 127–202.

134. RIDLEY, H. N. The natural history of Kedah Peak. V. Botany. Journ. F. M. S. Mus. 7 (1916) 37–58.

135. RIDLEY, H. N. Results of an expedition to Korinchi Peak, Sumatra, Part IV, Botany. Journ. F. M. S. Mus. 8 (1917) 9–136.

136. RIDLEY, H. N. New and rare Malayan plants, Series X. Journ. Str. Br. Roy. As. Soc. 79 (1918) 63–100.

137. RIDLEY, H. N. New and rare plants from the Malay Peninsula. Journ. F. M. S. Mus. 10 (1920) 128–156.

138. RIDLEY, H. N. Rigiolepis and other Vacciniaceæ of Borneo. Kew Bull. (1922) 106–108.

139. RIDLEY, H. N. The flora of Klang Gates, Selangor. Journ. F. M. S. Mus. 10 (1922) 247–251.

140. RIDLEY, H. N. The flora of the Malay Peninsula 2 (1923) 204–222.

141. RIDLEY, H. N. A botanical excursion to northern Sumatra. Journ. Mal. Br. Roy. As. Soc. 1 (1923) 46–113.

142. RIDLEY, H. N. New Malayan plants. Journ. of Bot. 62 (1924) 294–301.

143. ROBINSON, C. B. Alabastra philippinensia, III. Philip. Journ. Sci. 6 (1911) Bot. 319–358.

144. SCHIMPER, A. F. W. Pflanzen-Geographie auf physiologischer Grundlage (1898) 767 (English translation by W. R. Fisher, P. Groom, and I. B. Balfour (1903) 730).

264504——8

145. SCHLECHTER, R. Die Ericaceen von Deutsch-Neu-Guinea. Engler's Bot. Jahrb. 55 (1917) 137–144, (1918) 145–194.

146. SCHUMANN, K., and K. LAUTERBACH. Die Flora der deutschen Schutzgebiete in der Südsee (1901) 487–488.

147. SCHUMANN, K., and K. LAUTERBACH. Nachträge zur Flora der deutschen Schutzgebiete in der Südsee (1905) 337–340.

148. SEEMAN, B. New South Sea Island plants. Journ. of Bot. 2 (1864) 70–77.

149. SKOTTSBERG, C. Artemisia, Scaevola, Santalum, and Vaccinium of Hawaii. Bishop Mus. Bull. 43 (1927) (Vaccinium, pp. 65–87).

150. SMITH, J. J. Vaccinium malaccense Wight var. celebense J. J. S. Bull. Jard. Bot. Buitenz. 2e sér. 8 (1912) 48–49.

151. SMITH, J. J. Vorläufige Beschreibungen neuer papuanischer Ericaceae. Bull. Jard. Bot. Buitenz. 2e sér. 8 (1912) 50–55.

152. SMITH, J. J. Ein neues *Rhododendron* (*Rh. agathodaemonis*) aus Neu Guinea. Fedde Repert. 12 (1913) 209.

153. SMITH, J. J. In Icones Bogorienses 4 (1910) t. 318–325, (1912) t. 331, (1913) t. 353, (1914) t. 381.

154. SMITH, J. J. Ericaceæ, in S. H. Koorders and T. Valeton, Bijdrage No. 13 tot de kennis der boomsoorten op Java. Meded. Dept. Landbouw 18 (1914) 88–169.

155. SMITH, J. J. Ericaceæ. Nova Guinea 12 (1914) 129–168, t. 29–52.

156. SMITH, J. J. Vorläufige Beschreibungen neuer papuanischer Ericaceae. Meded. Rijks Herb. Leiden 25 (1915).

157. SMITH, J. J. Einige Ericaceen des leidener Herbariums. Meded. Rijks Herb. Leiden 30 (1916).

158. SMITH, J. J. Ericaceæ. Nova Guinea 12 (1917) 495–537, t. 193–223.

159. SMITH, J. J., in L. S. Gibbs. Dutch N. W. New Guinea. A contribution to the phytogeography and flora of the Arfak Mountains. (1917) 168–174.

160. SMITH, J. J. Plantae novae vel criticae ex herbario et horto bogoriensi. I. Bull. Jard. Bot. Buitenz. 3e sér. 1 (1920) 390–410, t. 38–56.

161. SMITH, W. W. Vaccinium borneënse W. W. Sm. Notes Bot. Gard. Edinburgh 8 (1915) 329.

162. STAPF, O. On the flora of Mount Kinabalu, in North Borneo. Trans. Linn. Soc. Bot. 4 (1894) 69–263, t. 11–20.

163. STEIN, B. Rhododendron Kochii Stein. Garten-flora 34 (1885) 193–194, t. 1195.

164. STEIN, B. Rhododendron apoanum Stein. Garten-flora 34 (1885) 194–195, t. 1196.

165. VIDAL Y SOLER, S. Sinopsis de familias y géneros de plantas leñosas de Filipinas. (1883).

166. VIDAL Y SOLER, S. Phanerogamae Cumingianae Philippinarum (1885) (review by R. A. Rolfe in Journ. of Bot. 24 (1886) 57–60).

167. VIDAL Y SOLER, S. Revisión de plantas vasculares Filipinas (1886) (review by R. A. Rolfe in Journ. of Bot. 24 (1886) 347–349).

168. WALLICH, N. Descriptions of some rare Indian plants. Asiatic Researches 13 (1820) 369–415, 13 t.

169. WARBURG, O. Beiträge zur Kenntnis der papuanischen Flora. Engler's Bot. Jahrb. 13 (1891) 230–455.

170. WARBURG, O. Bergpflanzen aus Kaiser Wilhelms-Land. Engler's Bot. Jahrb. 16 (1893) 1–32, t. 1.

171. WARBURG, O. Plantae Hellwigianae. Beitrag zur Flora von Kaiser Wilhelms-Land. Engler's Bot. Jahrb. 18 (1894) 184–212.

172. WARBURG, O. Ericaceae. Perkins Frag. Fl. Philip. (1905) 172–175.

173. WERNHAM, H. F., in H. N. Ridley and others. Report on the botany of the Wollaston Expedition to Dutch New Guinea. Trans. Linn. Soc. Bot. 9 (1916) 89–100.

174. WIGHT, R. Icones plantarum Indiae orientalis or figures of Indian plants 4 (1850) t. 1180–1203.

175. WIGMAN, H. J. Rhododendron javanicum Rnwdt. Teysmannia 20 (1909) 111–113, t. 1.

176. WILSON, E. H. The Rhododendrons of eastern Asia, the Bonin and Liukiu Islands and of Formosa. Journ. Arn. Arb. 6 (1925) 156–186.

177. WILSON, E. H., and A. REHDER. A monograph of Azaleas. Publications of the Arnold Arboretum No. 9 (1921).

178. WRIGHT, C. H. In Flora of British New Guinea. Kew Bull. (1899) 102–104.

179. ZOLLINGER, H. Observations phytographicae praecipue genera et species nova nonnulla respicientes. Nat. en Geneesk. Arch. 2 (1845) 1–19 (non vidi).

180. ZOLLINGER, H. Systematisches Verzeichniss der im indischen Archipel in den Jahren 1842–48 sowie der aus Japan empfangenen Pflanzen (1854–1855) (non vidi).

ILLUSTRATIONS

PLATE 1

FIG. 1. *Gaultheria leucocarpa, Palmer and Bryant 1117,* stamen, × 20.
2. *Gaultheria cumingiana, Clemens 16392,* stamen, × 20.
3. *Gaultheria psilocarpa,* type, stamen, × 20.

FIGS. 4 and 5. *Gaultheria benguetensis,* type, stamens, × 20.

FIG. 6. *Diplycosia loheri,* cotype, foliage and flowers, natural size.
7. *Diplycosia loheri,* type, stamen, × 10.

PLATE 2

FIG. 1. *Diplycosia trinervia, Elmer 13800,* stamens, × 10.
2. *Diplycosia trinervia, Elmer 13800* foliage and flowers, natural size.
3. *Diplycosia luzonica, For. Bur. 30072 Sulit,* flower, × 5.
4. *Diplycosia luzonica, For. Bur. 30072 Sulit,* flower in longitudinal section, × 5.
5. *Diplycosia luzonica, For. Bur. 7892 Curran and Merritt,* immature fruit, × 5.
6. *Diplycosia luzonica, Clemens 17822,* seeds, × 20.

PLATE 3

FIG. 1. *Diplycosia luzonica, For. Bur. 30072 Sulit,* stamen and anther, × 10.
2. *Diplycosia luzonica, Merrill 5670,* stamen, × 10.
3. *Diplycosia luzonica, For. Bur. 4779 Mearns and Hutchinson,* stamen, × 10.
4. *Diplycosia luzonica, Bur. Sci. 38540 Ramos and Edaño,* stamen, × 10.
5. *Diplycosia luzonica, Quisumbing, 1306,* foliage and flowers, natural size.

PLATE 4

FIG. 1. *Diplycosia luzonica, Merrill 5670,* foliage, natural size.
2. *Diplycosia apoensis,* type, foliage, natural size.

PLATE 5

FIG. 1. *Diplycosia calelanensis, Bur. Sci. 31784 Santos,* foliage, natural size.
2. *Diplycosia opaca,* type, foliage, natural size.
3. *Diplycosia sp., Elmer 11676,* stamen and anther, × 10.

PLATE 6

FIG. 1. *Iaera lanaensis, Clemens s. n.,* fruit, × 5.
2. *Iaera lanaensis, Elmer 10103,* stamen, × 20.
3. *Iaera lanaensis, Bur. Sci. 35683 Martelino and Edaño,* stamen, × 20.

FIG. 4. *Iaera lanaensis, Elmer 10103,* foliage and fruit, natural size.
5. *Iaera lanaensis,* type, seed, × 20.
6. *Iaera lanaensis, Bur. Sci. 35683 Martelino and Edaño,* flower, × 5.
7. *Iaera lucida,* type, stamen, × 20.
8. *Iaera lucida,* type fruit, × 5.
9. *Iaera lucida,* cotype, foliage and buds, natural size.

PLATE 7

FIG. 1. *Iaera loheri, Loher 13248,* leaf, × 2½.
2. *Iaera loheri, Loher 13248,* fruit, × 5.
3. *Iaera loheri, Loher 13248* foliage and fruit, natural size.
4. *Iaera loheri, Loher 13248,* flower-bud, × 10.
5. *Iaera loheri, Loher 13248,* stamens, × 20.
6. *Dimorphanthera apoana, Whitford 1497,* flower, × 5.
7. *Dimorphanthera apoana, Whitford 1497,* ovary in cross section, diagrammatic, × 20.

PLATE 8

FIG. 1. *Dimorphanthera apoana,* type, minor stamen, × 10.
2. *Dimorphanthera apoana,* type, major stamen, × 10.
3. *Dimorphanthera apoana, Whitford 1497,* three stamens, ×10.
4. *Dimorphanthera apoana, Williams 2550,* foliage and fruit, natural size.

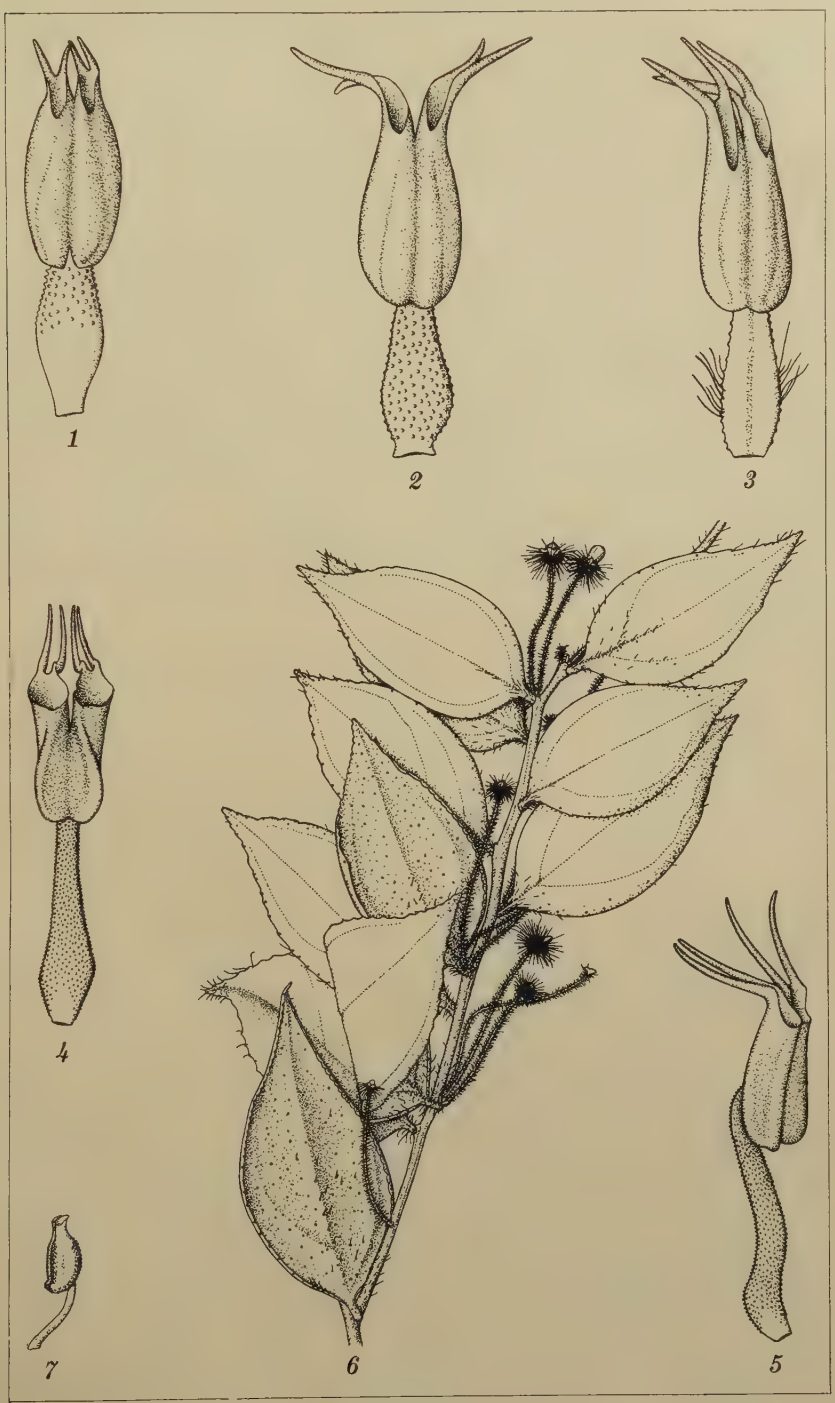


PLATE 1.

PLATE 2.

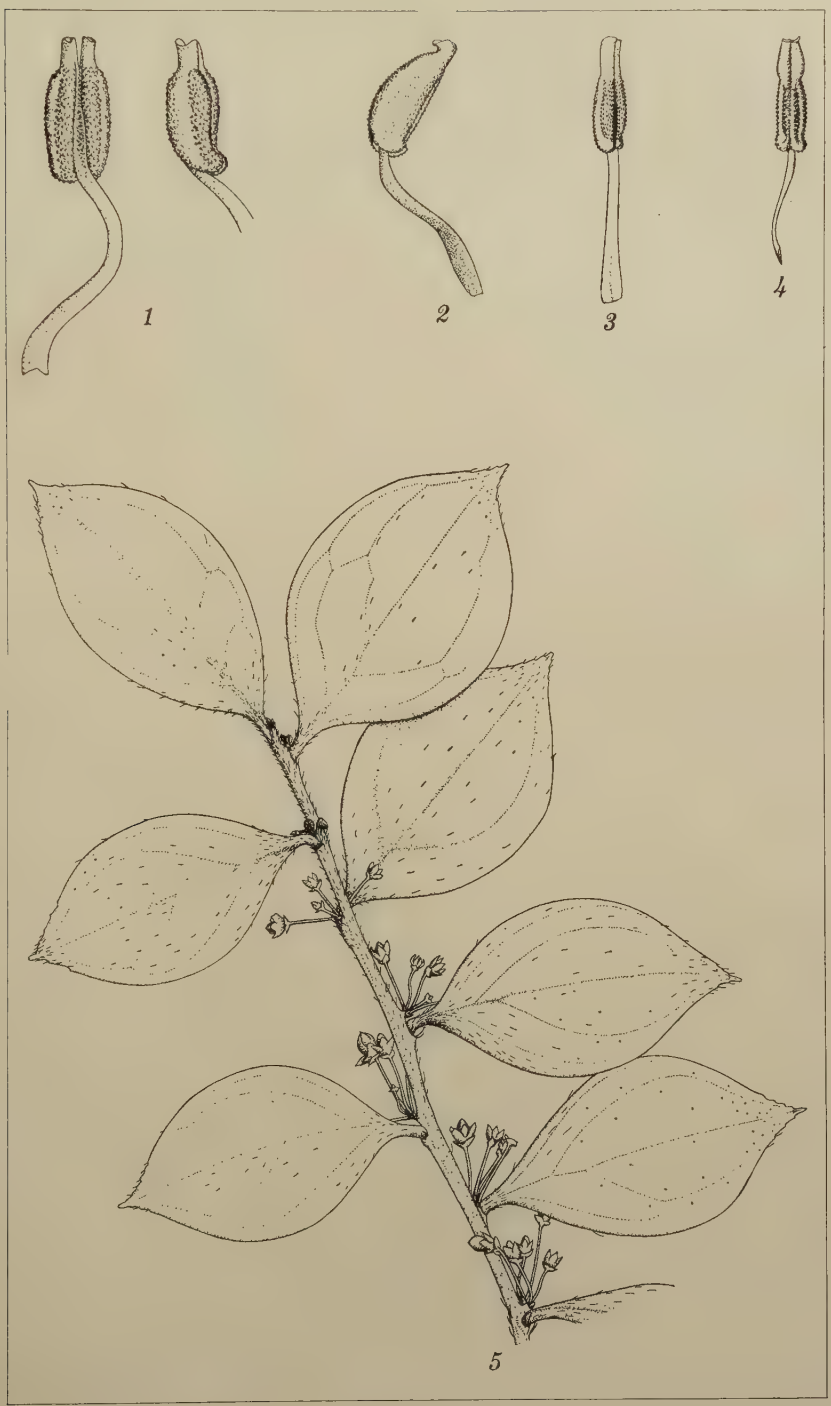


PLATE 3.

PLATE 4.

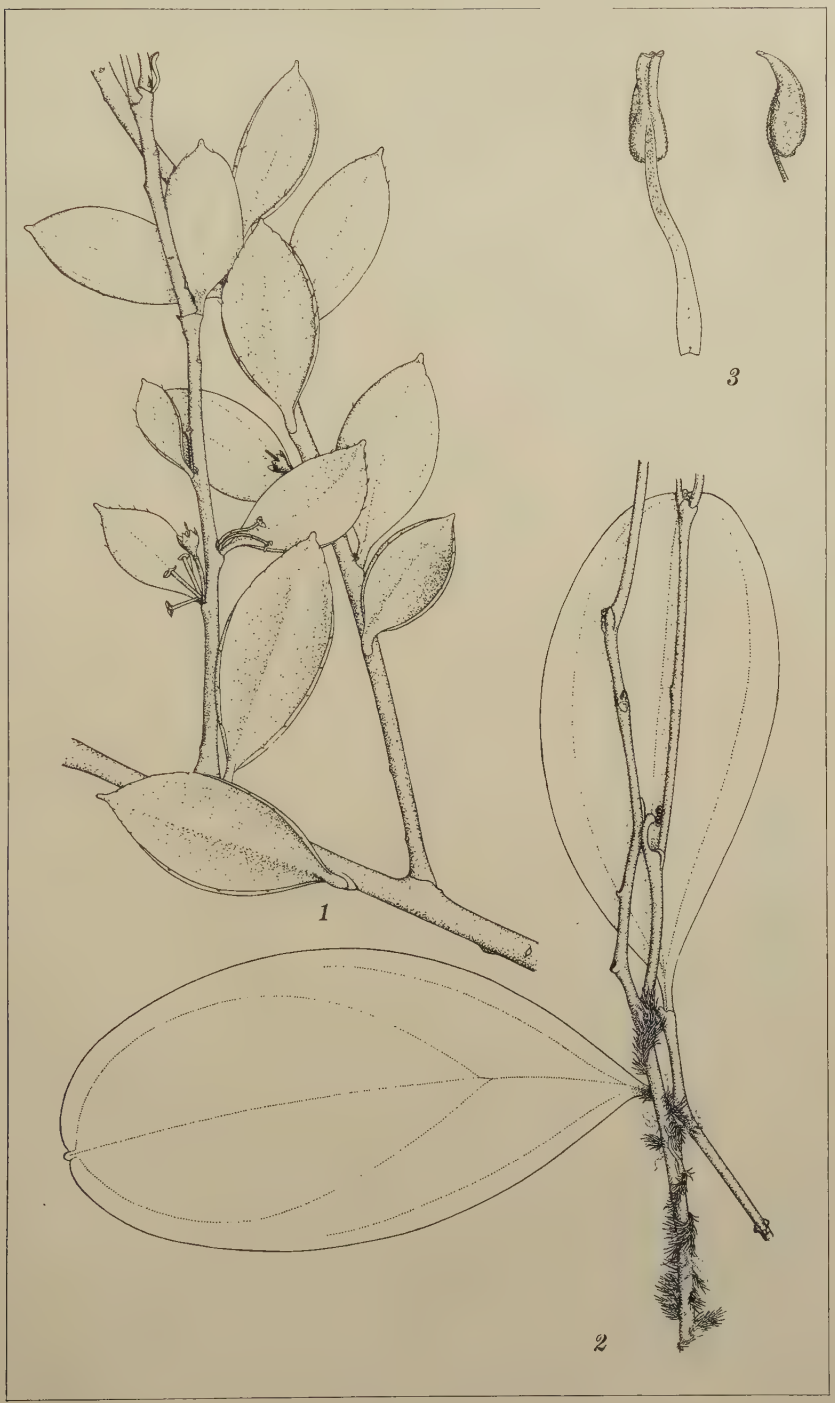


PLATE 5.

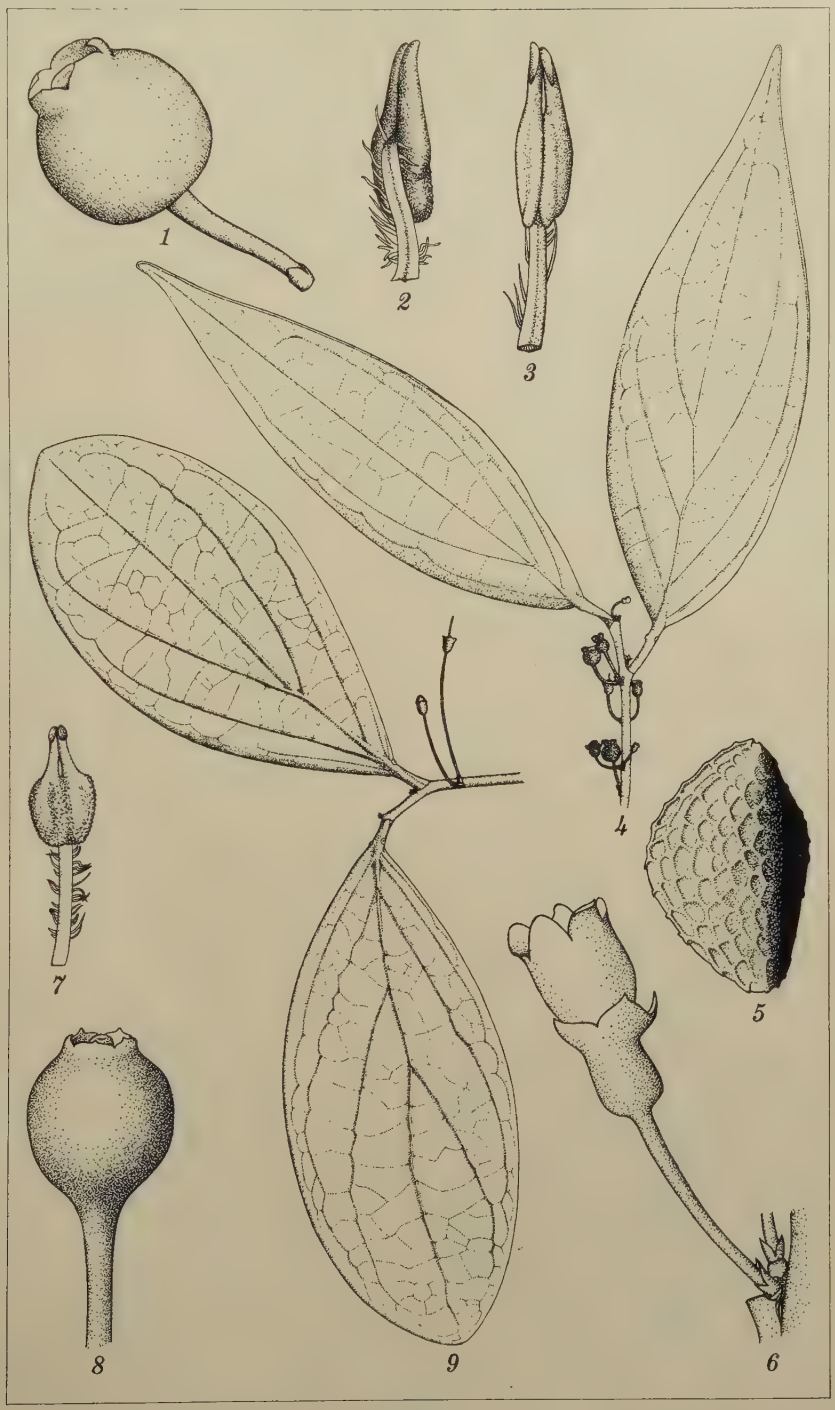


PLATE 6.

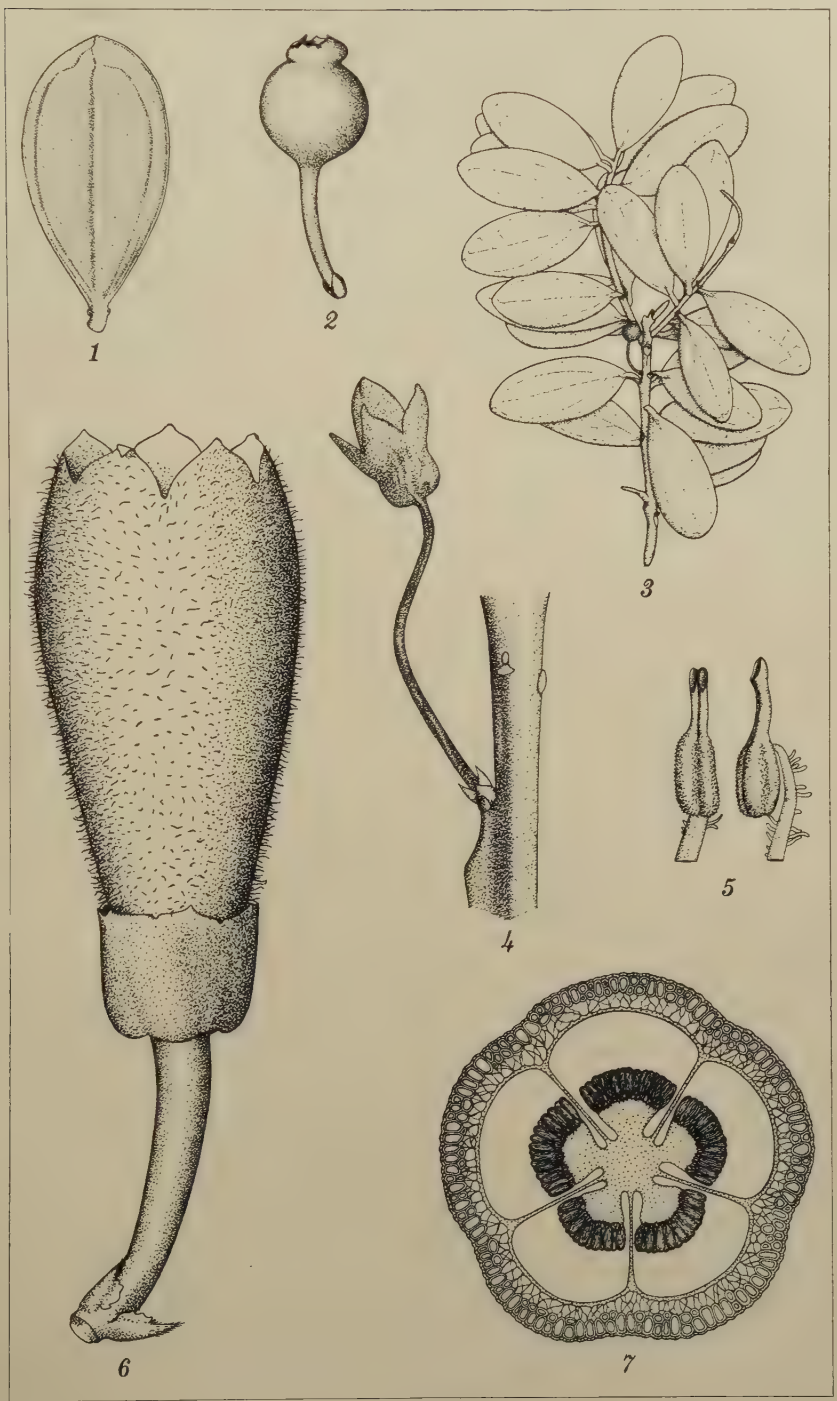


PLATE 7.

PLATE 8.

MARINE DIATOMS FROM THE KANAZAWA OYSTER EXPERIMENTAL STATION OF JAPAN

By B. W. Skvortzow
Of Harbin, China

TWO PLATES

The following notes on diatoms of the coast of Japan have resulted from the examination and study of a sample of marine diatoms received from Dr. Juzo Hori, of the Kanazawa Oyster Experimental Station at Kanazawa, Kanazawa-Ken, Japan, in December, 1927. The material was sufficiently rich in diatoms and the present paper lists forty-nine species and varieties, including some new forms not yet described.

MELOSIRA JUERGENSI Agardh.

V. Heurck, Synopsis pl. 86, figs. 1–8.

Length, 0.02 millimeter; breadth, 0.013 to 0.015 millimeter. Geographic distribution: North and Mediterranean Seas, Pacific Ocean.

MELOSIRA SULCATA (Ehrenb.) Kützing.

A. Schmidt, Atlas Diatom. pl. 176, figs. 28, 32–39, 42–44, 46; pl. 178, figs. 1-5, 7-19, 22-24.

Length, 0.01 millimeter; breadth, 0.04 to 0.05 millimeter. Geographic distribution: North and Mediterranean Seas, Pacific Ocean.

CYCLOTELLA STYLORUM Brightwell. Plate 2, fig. 1.

A. Schmidt, Atlas Diatom. pl. 223, figs. 6–8.

Valve 0.065 to 0.075 millimeter in diameter. Geographic distribution: Pacific Ocean, North and Mediterranean Seas, Sea of Japan.

CYCLOTELLA STRIATA (Kützing) Grunow. Plate 2, fig. 3.

Valve 0.025 to 0.043 millimeter in diameter. Striæ 12 to 14 in 0.01 millimeter. Geographic distribution: North, Mediterranean, and Yellow Seas, Japan, Philippine Islands.

CYCLOTELLA STRIATA (Kützing) Grunow var. BIPUNCTATA Fricke. Plate 2, fig. 2.

A. SCHMIDT, Atlas Diatom. pl. 223, figs. 15–19.

Valve with two distinct markings. Diameter 0.012 to 0.018 millimeter. Geographic distribution: North Sea.

COSCINODISCUS EXCENTRICUS Ehrenberg.

A. SCHMIDT, Atlas Diatom. pl. 58, figs. 46–49.

Valve 0.032 millimeter in diameter. Markings 5 to 7 in 0.01 millimeter. Geographic distribution: Pacific Ocean, Japan, North and Yellow Seas, Philippine Islands.

COSCINODISCUS DECRESCENS Grunow.

A. SCHMIDT, Atlas Diatom. pl. 61, figs. 7–10.

Valve 0.034 millimeter in diameter. Markings 4 in 0.01 millimeter. Geographic distribution: Pacific Ocean; fossil in marine deposits.

COSCINODISCUS EXTRAVAGANS A. Schmidt. Plate 1, fig. 3.

A. SCHMIDT, Atlas Diatom. pl. 58, fig. 33.

Valve blue, 0.032 to 0.038 millimeter in diameter. Central space distinct, circular. Markings small, granular, about 7 to 8 in 0.01 millimeter. Rows radial. Apiculi large, conical, interfasciculate, inserted at inner edge of marginal zone. Border hyaline. Geographic distribution: Japan.

COSCINODISCUS CONCINNUS W. Smith.

A. SCHMIDT, Atlas Diatom. pl. 114, figs. 8, 9.

Diameter of valves 0.046 to 0.056 millimeter. Geographic distribution: Pacific and Atlantic Oceans, Sea of Japan.

COSCINODISCUS OCULUS IRIDIS Ehrenberg. Plate 1, fig. 2.

A. SCHMIDT, Atlas Diatom. pl. 63, figs. 6, 7, 9; pl. 113, figs. 1, 3, 5, 20.

Diameter of valve 0.18 to 0.195 millimeter. Markings in the middle 4, at the border 3 in 0.01 millimeter. Geographic distribution: Pacific and Atlantic Oceans, Japan, China, Philippine Islands.

COSCINODISCUS DENARIUS A. Schmidt.

A. SCHMIDT, Atlas Diatom. pl. 5, figs. 19–21.

Diameter of valve 0.054 to 0.065 millimeter. Markings 7 to 8 in 0.01 millimeter. Geographic distribution: Atlantic Ocean, Sea of Japan.

COSCINODISCUS GIGAS Ehrenberg. Plate 1, fig. 5.

A. SCHMIDT, Atlas Diatom. pl. 64, fig. 1.

Valve 0.1 to 0.12 millimeter in diameter with 5 to 6 markings in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Mediterranean Sea, Japan.

COSCINODISCUS ASTEROMPHALUS Ehrenberg. Plate 1, figs. 1, 4, 7.

A. SCHMIDT, Atlas Diatom. pl. 63, fig. 5.

Diameter of valve 0.23 to 0.37 millimeter; markings 3 to 3.5 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, North Sea, Sea of Japan.

ASTEROMPHALUS FLABELLATUS Brébisson. Plate 2, fig. 14.

A. SCHMIDT, Atlas Diatom. pl. 38, figs. 10–12.

Diameter of valves 0.035 to 0.038 millimeter. Geographic distribution: Pacific Ocean, Japan, Hongkong, Indian Ocean.

ACTINOCYCLUS EHRENBERGI Ralfs. Plate 1, fig. 6.

V. HEURCK, Synopsis pl. 123, fig. 7.

Diameter of valve 0.97 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Japan, China, Philippine Islands.

ACTINOPTYCHUS UNDULATUS (Bailey) Ralfs. Plate 2, fig. 4.

V. HEURCK, Synopsis pl. 122, figs. 1–3.

Diameter of valves 0.03 to 0.05 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Japan and Yellow Seas.

LICMOPHORA FLABELLATA Agardh.

V. HEURCK, Synopsis pl. 46, fig. 2.

Valves 0.139 to 0.154 millimeter in length. Geographic distribution: North and Mediterranean Seas.

SYNEDRA AFFINIS Kütz. var. PARVA Grunow.

V. HEURCK, Synopsis pl. 41, fig. 22.

Length, 0.032 to 0.04 millimeter; breadth, 0.0034 to 0.0042 millimeter. Striæ 18 in 0.01 millimeter. Geographic distribution: North and Mediterranean Seas, Japan, Ceylon.

EUCAMPIA ZODIACUS Ehrenberg.

V. HEURCK, Synopsis pl. 95, figs. 17–18.

Cell elliptical with oval foramina. Geographic distribution: Atlantic and Pacific Oceans, Malay Archipelago, Sea of Japan.

GRAMMATOPHORA ARCTICA Cleve.

V. HEURCK, Synopsis pl. 53, fig. 3.

Valve minute, rectangular. Length and breadth, 0.013 millimeter. Geographic distribution: North Sea, Spitzbergen, Sea of Japan.

GRAMMATOPHORA OCEANICA Ehrenberg var. ADRIATICA Grunow.

V. HEURCK, Synopsis pl. 53, fig. 9.

Length, 0.018 to 0.034 millimeter; width, 0.004 to 0.01 millimeter. Geographic distribution: Adriatic Sea and Pacific Ocean.

GRAMMATOPHORA OCEANICA Ehrenberg var. NODULOSA Grunow.

PERAGALLO, Diatom. Mar. France. pl. 87, fig. 21.

Length, 0.025 millimeter; breadth, 0.012 millimeter. Geographic distribution: Atlantic Ocean, Mediterranean Sea.

ACHNANTHES BREVIPES Agardh var. TYPICA Cleve.

V. HEURCK, Synopsis pl. 26, figs. 10 to 12.

Valve constricted in the middle. Length, 0.076 millimeter; breadth, 0.022 millimeter. Striæ 5 in 0.01 millimeter. Geographic distribution: Brackish waters. Arctic America, Greenland, Spitzbergen, Finmark, North, Baltic, and Caspian Seas, Japan.

ACHNANTHES BREVIPES Agardh var JAPONICA var. nov. Plate 2, figs. 12–13.

Valve linear-elliptical with rounded ends. Length, 0.127 to 0.136 millimeter; breadth, 0.017 to 0.019 millimeter. Striæ 7 to 10 in 0.01 millimeter. This new variety resembles a large form of var. *intermedia* Kützing and *A. greenlandica* Cleve.

ACHNANTHES BREVIPES Agardh var. INTERMEDIA Kütz.

Valve linear-elliptical. Length, 0.049 millimeter; breadth, 0.008 millimeter. Geographic distribution: Brackish water and marine. Finmark, coasts of Britain, North, Baltic, Caspian, and Mediterranean Seas, Sea of Japan.

ACHNANTHES LONGIPES Agardh. Plate 2, figs. 10, 11.

V. HEURCK, Synopsis pl. 26, figs. 13 to 16.

Valve linear-elliptical, constricted in the middle, and with cuneate ends. Length, 0.081 to 0.119 millimeter; breadth, 0.025 to 0.029 millimeter. Geographic distribution: Brackish water and marine. Coasts of Britain, Baltic, North, Adriatic, and Mediterranean Seas, Belgium, Saint Paul Island.

ACHNANTHES LONGIPES Agardh forma LATA Peragallo. Plate 2, figs. 7–9.

PERAGALLO, Diatom. Mar. France pl. 1, figs. 10, 11.

Valve broad-elliptic with cuneate ends. Length, 0.054 millimeter; breadth, 0.024 millimeter. Striæ 5 in 0.01 millimeter.

COCCONEIS SCUTELLUM Ehrenberg var. BALDJIKIANA Grunow. Plate 2, fig. 5.

A. SCHMIDT, Atlas Diatom. pl. 190, figs. 7 to 10.

Valve elliptical. Length, 0.032 to 0.046 millimeter; breadth, 0.018 to 0.022 millimeter. Geographic distribution: North, Mediterranean, and Baltic Seas, Baldjik (fossil).

COCCONEIS SCUTELLUM Ehrenberg var. ELONGATA var. nov.

Valve elliptical elongate. Upper valve with puncta arranged in transverse rows. Lower valve delicate with a marginal rim or line. Median lines straight. Central nodules rounded. Length, 0.034 millimeter; breadth, 0.013 millimeter. Striæ 10 in 0.01 millimeter.

COCCONEIS PLACENTULA Ehrenberg.

A. SCHMIDT, Atlas Diatom. pl. 192, figs. 38 to 51.

Valve elliptic. Length, 0.047 millimeter; breadth, 0.037 millimeter. Striæ 22 in 0.01 millimeter. Geographic distribution: Fresh or brackish waters. Europe, Baltic and Caspian Seas, Tasmania, New Zealand, Illinois, California, Siberia.

NAVICULA CLAVATA Gregory var. CARIBOENA A. Schmidt forma MINOR Cleve.

A. SCHMIDT, Atlas Diatom. pl. 2, fig. 17; pl. 70, fig. 48.

Valve elliptical with rostrate ends. Lateral areas constricted in the middle. Length, 0.037 millimeter; breadth, 0.023 millimeter. Striæ 10 to 12 in 0.01 millimeter. Geographic distribution: Jamaica, North and Mediterranean Seas, Colon.

NAVICULA SCOPULORUM Brébisson.

V. HEURCK, Synopsis 99, Suppl. B, fig. 28.

Valve linear, slightly gibbous in the middle. Ends broad, rounded. Length, 0.21 to 0.023 millimeter; breadth, 0.016 to 0.018 millimeter. Striæ distinctly punctate, 20 in 0.01 millimeter. Geographic distribution: England, Mediterranean and Adriatic Seas, Sumatra, Labuan, Japan, East Cape, North Siberia, Brazil.

NAVICULA GRANULATA Bailey.

A. SCHMIDT, Atlas Diatom. pl. 6, figs. 26, 27.

Valve elliptic-lanceolate. Length, 0.085 millimeter; breadth, 0.037 millimeter. Striæ 9 in 0.01 millimeter. Geographic distribution: North and Mediterranean Seas, Ceylon, Japan, Sydney, California guano.

NAVICULA VIRIDULA Kützing var. ROSTELLATA Kützing.

V. HEURCK, Synopsis pl. 7, fig. 23.

Valve lanceolate with attenuated ends. Length, 0.044 millimeter; breadth, 0.008 millimeter. Striæ 8 to 9 in 0.01 millimeter. Geographic distribution: Brackish waters. England, Belgium, East Cape, Japan.

NAVICULA (SCHIZONEMA) MOLLIS W. Smith.

Valve lanceolate, obtuse. Length, 0.034 millimeter; breadth, 0.007 millimeter. Striæ 13 to 15 in 0.01 millimeter. Geographic distribution: Adriatic and North Seas.

NAVICULA (SCHIZONEMA) GREVILLEI Agardh.

Valve lanceolate with rounded ends. Length, 0.047 millimeter; breadth, 0.015 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Spitzbergen, Finmark, North Sea, coasts of England, Arctic America, Greenland, Cape Deschneff, West Indies, Kerguelen Land, California.

CALONEIS LIBER W. Smith var. LINEARIS Grunow.

Valve linear with parallel margins and rounded ends. Length, 0.045 millimeter; breadth, 0.01 millimeter. Striæ 21 in 0.01 millimeter. Geographic distribution: Atlantic coasts of Europe, Africa and America, Japan Sea, Vladivostok, Ceylon, Singapore, Galapagos Islands, Peru, Honduras, Gulf of Mexico.

PLEUROSIGMA STUXBERGII Cleve and Grunow var. LATUISCULA Peragallo.

PERAGALLO, Monogr. Pleurosigma 15, pl. 6, fig. 12.

Valve lanceolate, slightly sigmoid. Ends obtuse. Length, 0.115 millimeter; breadth, 0.022 millimeter. Transverse and oblique striæ 23/20 in 0.01 millimeter. Geographic distribution: North and Mediterranean Seas.

PLEUROSIGMA ELONGATUM W. Smith.

PERAGALLO, Monogr. Pleurosigma pl. 3, figs. 5 to 8.

Valve elongate, slightly sigmoid, attenuate to the acute ends. Length, 0.23 millimeter; breadth, 0.02 millimeter. Geographic

distribution: Spitzbergen, Atlantic coast of North America, North, Mediterranean, Adriatic, Baltic, and Caspian Seas, Java, Sumatra, China, Tahiti, Medoc.

PLEUROSIGMA ANGULATUM Quekett.

PERAGALLO, Monogr. Pleurosigma pl. 5, fig. 3.

Valve rhomboidal-lanceolate, slightly angular in the middle. Length, 0.102 millimeter; breadth, 0.02 millimeter. Geographic distribution: North Sea, Barbados deposits.

PLEUROSIGMA NUBICULA W. Smith var. INTERMEDIA W. Smith.

PERAGALLO, Monogr. Pleurosigma pl. 5, figs. 27, 28.

Valve narrow-lanceolate not sigmoid, with long ends. Length, 0.18 millimeter; breadth, 0.0136 millimeter. Striæ 25/25 in 0.01 millimeter. Geographic distribution: North Sea, Port Jackson, Sea of Japan.

PLEUROSIGMA ACUMINATUM Kützing var. GALLICA Grunow.

Valve sigmoid, lanceolate with attenuate ends. Length, 0.127 millimeter; breadth, 0.025 millimeter. Striæ 25 in 0.01 millimeter. Geographic distribution: Fresh and brackish waters. Sweden, France, Argentina.

AMPHORA ANGUSTA (Greg.) Cleve var. VENTRICOSA Gregory forma JAPONICA forma nov.

Valve narrow, semilanceolate, acute. Length, 0.068 millimeter; breadth, 0.008 millimeter. Striæ 15 in 0.01 millimeter.

GOMPHONEMA KAMTSCHATICUM Grunow var. JAPONICA Skvortzow.

Marine Diatom. Siber. Shore 17, fig. 17.

Length, 0.02 millimeter; breadth, 0.003 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Sea of Japan.

NITSCHIA VIVAX Smith var. JAPONICA var. nov.

Valve lanceolate with subrostrate ends. Length, 0.093 to 0.0068 millimeter. Coarse border lines 7 in 0.01 millimeter. Fine lines 25 to 30 in 0.01 millimeter.

NITSCHIA LORENZIANA Grunow var. DENSESTRIATA Peragallo.

A. SCHMIDT, Atlas Diatom. pl. 335, figs. 9–11.

Length, 0.136 millimeter; breadth, 0.007 millimeter. Fine striæ 25 in 0.01 millimeter. Coarse margin lines 6 in 0.01 millimeter. Geographic distribution: North and Mediterranean Seas, Borneo, Ceylon.

NITZSCHIA LONGISSIMA Brébisson.

PERAGALLO, Diatom. Mar. France pl. 74, fig. 20.

Length, 0.51 to 0.65 millimeter; breadth, 0.01 millimeter. Geographic distribution: Adriatic, North, and Mediterranean Seas, Atlantic Ocean, Japan.

NITSCHIA SOCIALIS Gregory var. BALTICA Grunow.

Length, 0.081 millimeter; breadth, 0.005 millimeter. Coarse dorsal lines 6 in 0.01 millimeter. Fine lines 20 in 0.01 millimeter. Geographic distribution: North Sea.

SURIRELLA FASTUOSA Ehrenberg. Plate 2, fig. 6.

A. SCHMIDT, Atlas Diatom. pl. 5, figs. 7, 8, 11.

Length, 0.034 to 0.064 millimeter; breadth, 0.025 to 0.047 millimeter. Geographic distribution: A cosmopolitan marine diatom.

ILLUSTRATIONS

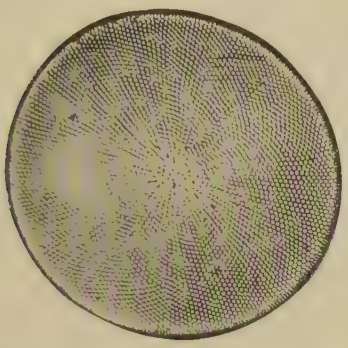
Plate 1

Fig. 1. *Coscinodiscus asteromphalus* Ehrenberg.
2. *Coscinodiscus oculus iridis* Ehrenberg.
3. *Coscinodiscus extravagans* Schmidt.
4. *Coscinodiscus asteromphalus* Ehrenberg.
5. *Coscinodiscus gigas* Ehrenberg.
6. *Actinocyclus ehrenbergi* Ralfs.
7. *Coscinodiscus asteromphalus* Ehrenberg.

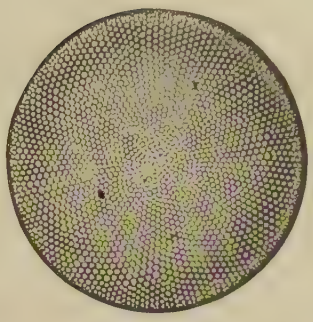
Plate 2

Fig. 1. *Cyclotella stylorum* Brightwell.
2. *Cyclotella striata* (Kützing) Grunow var. *bipunctata* Fricke.
3. *Cyclotella striata* (Kützing) Grunow.
4. *Actinoptychus undulatus* (Bail.) Ralfs.
5. *Cocconeis scutellum* Ehrenberg var. *baldjikiana* Grunow.
6. *Surirella fastuosa* Ehrenberg.

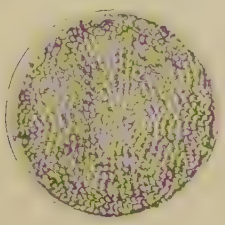
Figs. 7 to 9. *Achnanthes longipes* Agardh forma *lata* Peragallo.
Figs. 10, 11. *Achnanthes longipes* Agardh.
Figs. 12, 13. *Achnanthes brevipes* Agardh var. *japonica* var. nov.
Fig. 14. *Asteromphalus flabellatus* Brébisson.



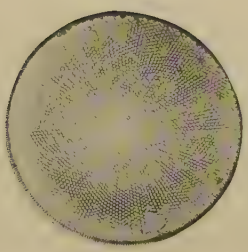
1



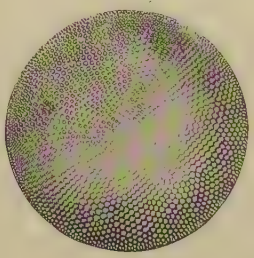
2



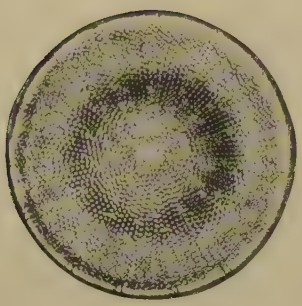
3



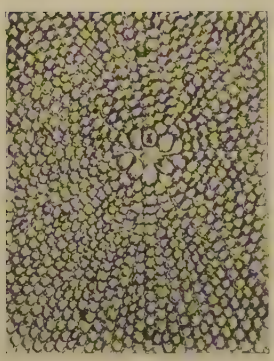
4



5



6



7

PLATE 1.

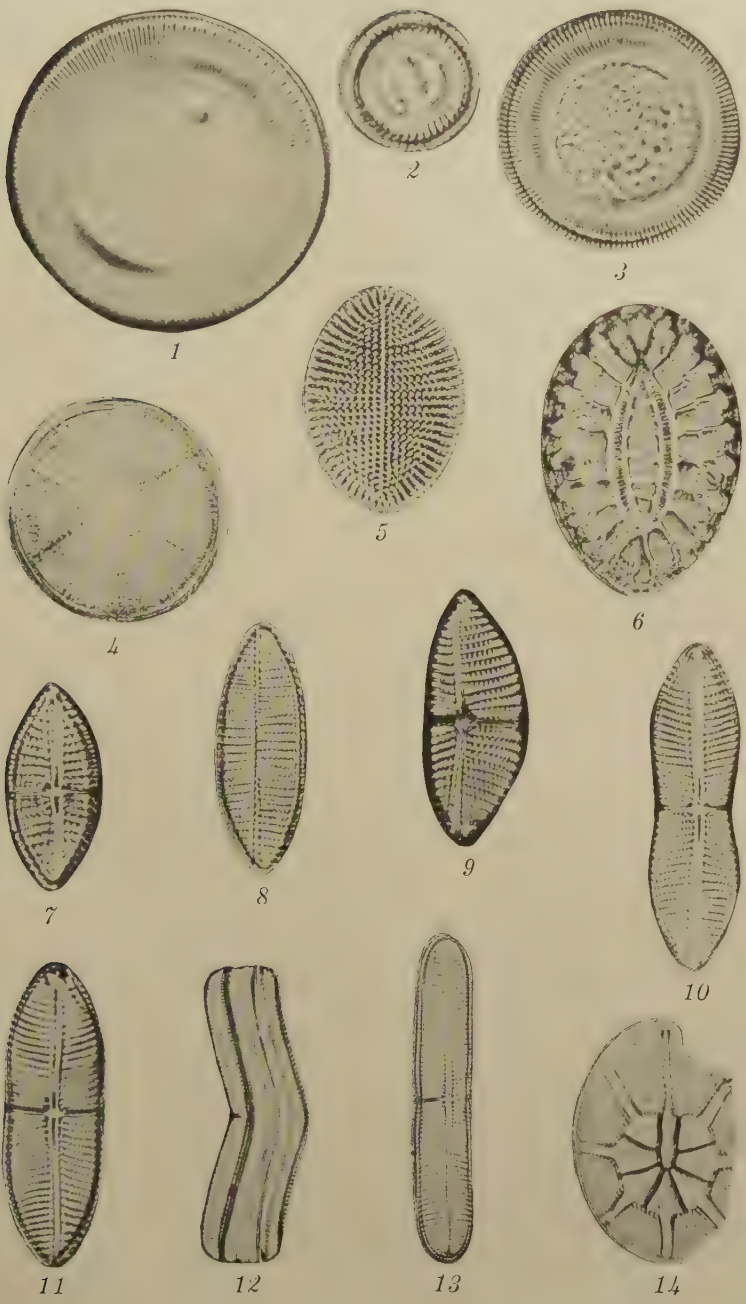


PLATE 2.

MARINE LITTORAL DIATOMS FROM ENVIRONS OF VLADIVOSTOK

By B. W. Skvortzow

Of Harbin, China

SIX PLATES

The diatoms of the northern part of the Sea of Japan are relatively very little known. Only two enumerations of forms observed in samples from Vladivostok have been published by me; one in the Botanical Magazine in Tokyo in 1929, the other in the Philippine Journal of Science in 1931. Scarcely more than forty-two marine species are enumerated in the papers quoted above. Since that time I have examined some new diatom material collected by me during my visit to Vladivostok in the summer of 1928. These new samples were taken from Golden Horn Bay and from Cape Basargino near the Pacific Fishery Research Station. Altogether six samples have been examined:

1. Basargino, near the seashore, from the twigs of *Sargassum* sp.
2. Basargino, near the seashore, from *Laminaria japonica.*
3. Basargino from oyster mud dredged by the Fishery Station.
4. Vladivostok, from the piles near the seashore.
5. Okeanskaya station from *Zostera* sp.
6. Okeanskaya station from *Sargassum* sp.

All mentioned samples, except sample 3, contained a large number of diatoms, typical of the littoral association with an epiphytic nature. Sample 3 was rich in different *Coscinodiscus, Cyclotella, Navicula,* and *Amphora.* Samples 5 and 6 from the seashore of Okeanskaya station had a number of diatoms known in brackish waters, as *Hyalodiscus, Licmophora, Synedra, Cocconeis, Nitschia,* and *Surirella.*

All the samples yielded one hundred thirty-two forms of these algæ, a list of which is given below. This note is illustrated with diagrams by the author and the number after each species corresponds to the locality from which it was obtained.

PODOSIRA MONTAGNEI Kützing.

V. Heurck, Synopsis pl. 84, figs. 9, 10.

Length, 0.088 to 0.009 millimeter; breadth, 0.03 to 0.06 millimeter. Geographic distribution: North, Mediterranean, and Caspian Seas, Ceylon. Samples 1, 5, and 6.

HYALODISCUS SCOTICUS (Kützing) Grunow.

PERAGALLO, Diatom. Mar. France 443, pl. 119, fig. 8.

Diameter of the valves 0.013 to 0.027 millimeter. Geographic distribution: Spitzbergen, Finmark, North and Black Seas. Samples 1, 3, and 5.

HYALODISCUS AMBIGUUS Grunow. Plate 1, fig. 1.

PERAGALLO, Diatom. Mar. France. pl. 19, fig. 19.

Diameter of the valves 0.127 to 0.13 millimeter. Diameter of umbilicus 0.01 millimeter. Striæ 18 in 0.01 millimeter. Geographic distribution: Atlantic Ocean, Mediterranean Sea. Samples 1 and 5.

STEPHANOPYXIS TURRIS (Grev. and Arn.) Ralfs var. INTERMEDIA Grunow. Plate 1, figs. 2, 3.

GRUNOW, Genkschr. Akad. Wissen. (1884) 35–37, figs. 15, 16.

Valves 0.017 to 0.02 millimeter thick. Geographic distribution: Atlantic and Pacific Oceans, known from the Sea of Japan. Sample 3.

CYCLOTELLA STRIATA (Kützing) Grunow. Plate 1, figs. 6–9.

Diameter of the valve 0.042 to 0.049 millimeter. Striæ 12 in 0.01 millimeter. Geographic distribution: North, Japan, and Yellow Seas, Philippine Islands. Sample 3.

CYCLOTELLA STRIATA (Kützing) Grunow var. AMBIGUA Grunow. Plate 1, figs. 4, 5.

V. HEURCK, Synopsis pl. 92, fig. 12.

Diameter of the valve 0.027 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Brackish waters. Sample 3.

COSCINODISCUS OCULUS IRIDIS Ehrenberg.

A. SCHMIDT, Atlas Diatom. pl. 63, figs. 6, 7, 9.

Diameter of the valve 0.161 to 0.25 millimeter. Markings 2 to 3 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Japan, China, Hongkong, Philippine Islands. Sample 3.

COSCINODISCUS LINEATUS Ehrenberg. Plate 2, fig. 8.

A. SCHMIDT, Atlas Diatom. pl. 59, figs. 31, 32.

Diameter of the valves 0.06 to 0.8 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Kamchatka, Sea of Japan, China and Yellow Seas. Samples 3 and 4.

COSCINODISCUS EXCENTRICUS Ehrenberg. Plate 3, fig. 2.

A. SCHMIDT, Atlas Diatom. pl. 58, figs. 46–49.

Diameter of the valves 0.047 to 0.062 millimeter. Markings 5 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Japan, Philippine Islands. Samples 3 and 4.

COSCINODISCUS RADIATUS Ehrenberg. Plate 2, figs. 2, 3, 4.

A. SCHMIDT, Atlas Diatom. pl. 60, figs. 1–6, 9, 10; pl. 61, fig. 13.

Diameter of the valves 0.119 to 0.135 millimeter. Markings 3 to 4 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Sea of Japan, China and Yellow Seas, Hongkong. Sample 3.

COSCINODISCUS DENARIUS A. Schmidt. Plate 2, figs. 5, 6.

A. SCHMIDT, Atlas Diatom. pl. 57, figs. 19–21.

Diameter of the valves 0.052 to 0.073 millimeter. Markings 4 to 6 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Sample 3.

COSCINODISCUS CURVATULUS Grunow.

A. SCHMIDT, Atlas Diatom. pl. 57, fig. 33.

Diameter of the valves 0.054 to 0.7 millimeter. Markings 6 to 7 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Sea of Japan. Samples 1 and 3.

COSCINODISCUS CURVATULUS Grunow var. MINOR (Ehrenberg) Grunow. Plate 2, fig. 9.

GRUNOW, Diatom. Franz Josef Land 33, pl. D, figs. 8, 10.

Diameter of the valves 0.027 to 0.035 millimeter. Markings 7 in 0.01 millimeter. Geographical distribution: North Sea. Sample 3.

COSCINODISCUS CURVATULUS Grunow var. JAPONICA var. nov. Plate 2, fig. 7.

Diameter of the valves 0.032 to 0.05 millimeter. Central space small granular or absent. Markings in fasciculate rows. Border distinct, nonapiculate. Sample 3.

COSCINODISCUS MARGINATUS Ehrenberg. Plate 2, fig. 1.

A. SCHMIDT, Atlas Diatom. pl. 62, figs. 1–5, 7, 11, 12.

Diameter of the valves 0.047 to 0.078 millimeter. Markings 3 to 4 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Kamchatka, Sea of Japan, China and Yellow Seas. Samples 1 and 3.

ACTINOPTYCHUS UNDULATUS (Bailey) Ralfs. Plate 3, fig. 1.

V. HEURCK, Synopsis pl. 122, figs. 1, 3.

Diameter of the valves 0.035 to 0.038 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Sea of Japan, Yellow and North Seas. Sample 3.

ASTEROMPHALUS HEPTACTIS (Brébisson) Ralfs. Plate 3, fig. 4.

A. SCHMIDT, Atlas Diatom. pl. 38, figs. 5–8.

Diameter of the valves 0.042 to 0.05 millimeter. Geographic distribution: Atlantic Ocean, California, Peru, Sea of Japan. Sample 3.

AULACODISCUS AMOENUS Greville. Plate 3, fig. 5.

A. SCHMIDT, Atlas Diatom. pl. 34, fig. 6; pl. 134, fig. 7.

Diameter of the valves 0.076 to 0.095 millimeter. Geographic distribution: Pacific Ocean, Sea of Japan. Samples 1 and 3.

AULISCUS COELATUS Bailey var. STRIGILLATA A. Schmidt. Plate 3, fig. 6.

A. SCHMIDT, Atlas Diatom. pl. 32, figs. 24–26.

Diameter of the valves 0.036 to 0.053 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Sea of Japan, Philippines. Sample 1.

RHIZOSOLENIA SETIGERA Brightwell.

PERAGALLO, Rhizosolenia pl. 4, figs. 12–16.

Valve 0.011 millimeter in breadth. Geographic distribution: Atlantic and Pacific Oceans, Sea of Japan, Philippines. Sample 3.

CHAETOCEROS COMPRESSUM Lauder.

A. SCHMIDT, Atlas Diatom. pl. 323, figs. 3–5; pl. 341, figs. 1, 9.

Valves 0.02 millimeter broad. Geographic distribution: Atlantic and Pacific Oceans, Sea of Japan. Sample 1.

BIDDULPHIA OBTUSA Grunow. Plate 6, fig. 10.

V. HEURCK, Synopsis pl. 100, figs. 11–14.

Length, 0.051 to 0.063 millimeter; breadth, 0.02 to 0.025 millimeter. Geographic distribution: New York, North and China Seas, Vladivostok, Philippines. Sample 5.

BIDDULPHIA AURITA Brébisson. Plate 3, fig. 9; Plate 6, fig. 3.

A. SCHMIDT, Atlas Diatom. pl. 122, figs. 1–8.

Length, 0.042 to 0.62 millimeter; breadth, 0.023 to 0.028 millimeter. Marginal spines distinct. Geographic distribution: At-

lantic and Pacific Oceans, Japan, Vladivostok, Yellow Sea, Philippines. Sample 1.

BIDDULPHIA AURITA Brébisson var. ORIENTALIS Mereschkovski. Plate 6, fig. 4.

MERESCHKOVSKY, on Polynesian Diatom. (1900–1902); A. SCHMIDT, Atlas Diatom. pl. 12, figs. 5–8.

Length, 0.056 to 0.067 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Sample 1.

RHABDONEMA ARCUATUM (Lyngbye) Kützing. Plate 5, fig. 3.

A. SCHMIDT, Atlas Diatom. pl. 220, figs. 17–22.

Length, 0.076 to 0.113 millimeter; breadth, 0.018 to 0.02 millimeter. Striæ 4.5 to 6 in 0.01 millimeter. Geographic distribution: Atlantic Ocean, Mediterranean Sea, Japan, Australia, Philippines. Sample 1.

GRAMMATOPHORA ANGULOSA Ehrenberg. Plate 6, fig. 5.

PERAGALLO, Diatom. Mar. France 357, pl. 88, figs. 11–13

Length, 0.017 to 0.039 millimeter; breadth, 0.008 to 0.018 millimeter. Striæ 12 to 15 in 0.01 millimeter. Geographic distribution: North Sea, California. Sample 1.

GRAMMATOPHORA ANGULOSA Ehrenberg var. ISLANDICA Ehrenberg. Plate 6, fig. 11.

PERAGALLO, Diatom. Mar. France pl. 88, figs. 14–15.

Length, 0.059 millimeter; breadth, 0.022 millimeter. Striæ 12 in 0.01 millimeter. Geographic distribution: Atlantic Ocean, North and Japan Seas. Sample 1.

GRAMMATOPHORA OCEANICA Ehrenberg var. MACILENTA Smith.

V. HEURCK, Synopsis 164, pl. 53, fig. 16.

Length, 0.022 to 0.078 millimeter; width, 0.006 to 0.007 millimeter. Geographic distribution: Adriatic Sea, Pacific Ocean, Japan, Philippines. Samples 1, 3, 5.

GRAMMATOPHORA MARINA (Lyngbye) Kützing.

V. HEURCK, Synopsis 163, pl. 53, fig. 10.

Length, 0.042 to 0.068 millimeter; breadth, 0.012 to 0.018 millimeter. Striæ 18 to 20 in 0.01 millimeter. Geographic distribution: Mediterranean Sea, Pacific Ocean, Japan, China, Philippines. Samples 1 and 5.

LICMOPHORA LYNGBYEI Kützing var. ELONGATA Grunow. Plate 6, fig. 7.

PERAGALLO, Diatom. Mar. France pl. 85, fig. 8.

Length, 0.085 to 0.111 millimeter; breadth, 0.005 millimeter. Geographic distribution: North Sea. Sample 5.

LICMOPHORA JURGENSII Agardh var. CHERSONENSIS Grunow.

V. HEURCK, Synopsis pl. 46, fig. 9.

Length, 0.0103 millimeter; breadth, 0.005 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: North and Mediterranean Seas. Samples 1 and 5.

LICMOPHORA JURGENSII Agardh var. CAPENSIS Grunow.

V. HEURCK, Synopsis pl. 46, fig. 8.

Length, 0.042 millimeter; breadth, 0.0076 to 0.0085 millimeter. Striæ 14 to 15 in 0.01 millimeter. Geographic distribution: Mediterranean and North Seas. Sample 4.

LICMOPHORA GRACILIS (Kützing) Ehrenberg. Plate 6, fig. 1.

V. HEURCK, Synopsis pl. 46, fig. 13.

Length, 0.034 millimeter; breadth, 0.007 millimeter. Geographic distribution: North and Mediterranean Seas. Sample 4.

LICMOPHORA COMMUNIS (Heib.) Grunow. Plate 6, fig. 2.

V. HEURCK, Synopsis pl. 48, figs. 8, 9.

Length, 0.013 to 0.054 millimeter; breadth, 0.015 millimeter. Geographic distribution: North and Mediterranean Seas. Samples 4 and 5.

SYNEDRA PULCHELLA Kützing.

A. SCHMIDT, Atlas Diatom. pl. 300, figs. 19–35.

Length, 0.074 to 0.046 millimeter; breadth, 0.0045 millimeter. Striæ 15 to 18 in 0.01 millimeter. Geographic distribution: Fresh and brackish waters. Sample 5.

SYNEDRA AFFINIS Kützing var. TABULATA Grunow. Plate 6, fig. 15.

V. HEURCK, Synopsis pl. 41, fig. 9A.

Valve 0.079 to 0.085 millimeter in length; 0.004 to 0.006 millimeter in breadth. Striæ 9 to 11 in 0.01 millimeter. Geographic distribution: Marine and brackish waters. A cosmopolitan diatom. Samples 2 and 4.

SYNEDRA AFFINIS Kützing var. HYBRIDA Grunow. Plate 6, fig. 14.

V. HEURCK, Synopsis pl. 41, fig. 9B.

Length, 0.119 to 0.175 millimeter; breadth, 0.0034 to 0.004 millimeter. Striæ 11 to 15 in 0.01 millimeter. Geographic distribution: Marine and brackish waters. Samples 1 and 5.

FRAGILARIA OCEANICA Cleve var. JAPONICA var. nov. Plate 6, fig. 9.

Valve elliptical-linear, with parallel margins. Ends slightly cuneate and rounded. Length, 0.019 to 0.21 millimeter; breadth,

0.003 to 0.004 millimeter. Striæ 15 in 0.01 millimeter. Sample 3.

FRAGILARIA OCEANICA Cleve var. ACUTA var. nov. Plate 6, fig. 8.

Valve elliptic-linear with acute, subrostrate, rounded ends. Striæ marginal, about 18 to 22 in 0.01 millimeter. Length of valve, 0.025 to 0.032 millimeter; breadth, 0.004 to 0.007 millimeter. Geographic distribution: Typical *F. oceanica* Cleve, Bihang K. Sv. Vet. Akad. Handl. Bd. 1, No. 13, 22, pl. 4, fig. 25, occurs in Arctic and Kara Seas. Sample 3.

THALASSIOTHRIX NITZSCHIOIDES Grunow.

V. HEURCK, Synopsis pl. 43, figs. 7–10.

Length, 0.023 to 0.025 millimeter; breadth, 0.0025 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Japan, China. Samples 1 and 4.

ACHNANTHES BREVIPES Agardh var. INTERMEDIA Kützing.

V. HEURCK, Synopsis 129, pl. 26, figs. 21–24.

Valve linear-elliptical with rounded ends. Length, 0.0408 to 0.054 millimeter; breadth, 0.0085 to 0.01 millimeter. Striæ 6 to 9 in 0.01 millimeter. Geographic distribution: Brackish and marine waters. Sample 6.

COCCONEIS ARCTICA Cleve.

A. SCHMIDT, Atlas Diatom. pl. 196, fig. 10; pl. 197, figs. 5, 6.

Valve elliptical. Length, 0.037 millimeter; breadth, 0.025 millimeter. Striæ 12 in 0.01 millimeter. Geographic distribution: Arctic America, Greenland, Finmark. Samples 2 and 5.

COCCONEIS PELLUCIDA Hantzsch.

A. SCHMIDT, Atlas Diatom. pl. 194, fig. 2; pl. 195, figs. 1–8.

Valve broadly elliptical. Length, 0.025 to 0.064 millimeter; breadth, 0.02 to 0.047 millimeter. Striæ 20 in 0.01 millimeter. Geographic distribution: Nicobar Islands, Java, Sumatra, Singapore, Sandwich Islands, Bering Island, Madagascar, New Zealand, fossil in Hungary and Haiti. Samples 5 and 6.

COCCONEIS PELLUCIDA Hantzsch var. MINOR Grunow.

GRUNOW, Novara Diatom. 13, pl. 1, fig. 7.

Valve elliptical. Length, 0.015 to 0.018 millimeter; breadth, 0.0085 to 0.010 millimeter. Geographic distribution: Red Sea, Saint Paul Island, Cape of Good Hope, Nicobar Islands, New Zealand, Trinidad. Samples 5 and 6.

COCCONEIS SCUTELLUM Ehrenberg var. STAURONEIFORMIS W. Smith.

V. HEURCK, Synopsis pl. 29, figs. 10, 11.

Valve minute, elliptical. Length, 0.019 millimeter; breadth, 0.011 millimeter. Puncta 10 in 0.01 millimeter. Geographic distribution: Arctic America, Spitzbergen, Finmark, East Cape, North and Mediterranean Seas, New Zealand, England. Sample 1.

COCCONEIS SCUTELLUM Ehrenberg var. PARVA Grunow.

V. HEURCK, Synopsis pl. 29, figs. 8, 9.

Valve minute, elliptical. Length, 0.013 to 0.029 millimeter; breadth, 0.009 to 0.012 millimeter. Striæ 6.5 to 7 in 0.01 millimeter. Geographic distribution: East Cape, Baltic, Adriatic, and Yellow Seas. Sample 1.

COCCONEIS SCUTELLUM Ehrenberg var. JAPONICA Skvortzow. Plate 3, fig. 7; Plate 4, figs. 1 to 8.

Marine Diatom. Siber. Shore (1929) 57, figs. 2, 14; Marine Diatom. Dairen, 421, pl. 1, fig. 8.

Valve with large loculi, arranged in more or less undulating longitudinal and transverse rows. Length, 0.042 to 0.061 millimeter; breadth, 0.034 to 0.045 millimeter. Puncta 4.5 in 0.01 millimeter. Geographic distribution: Sea of Japan, Vladivostok and Dairen. Samples 1 and 6.

COCCONEIS SCUTELLUM Ehrenberg var. ORNATA Grunow. Plate 3, fig. 11.

V. HEURCK, Synopsis pl. 29, figs. 6, 7.

Valve broadly elliptical. Length, 0.035 millimeter; breadth, 0.025 millimeter. Geographic distribution: Pacific Ocean, Kamchatka and Yellow Seas. Sample 1.

COCCONEIS COSTATA Gregory var. TYPICA Cleve.

V. HEURCK, Synopsis pl. 30, figs. 11, 12.

Valve elliptic with strong transverse costæ. Length, 0.017 millimeter; breadth, 0.085 millimeter. Geographic distribution: Arctic America, Greenland, Davis Strait, Canada, Spitzbergen, Finmark, Bering Island, North Mediterranean and Adriatic Seas. Samples 2 and 6.

COCCONEIS DIRUPTA Gregory var. ANTARCTICA Grunow. Plate 3, fig. 10.

V. HEURCK, Synopsis pl. 29, figs. 18, 19.

Valve broad elliptical. Length, 0.044 millimeter; breadth, 0.032 millimeter. Striæ about 12 in 0.01 millimeter. Geographic distribution: New Zealand, China. Sample 1.

COCCONEIS DIRUPTA Gregory var. SIGMA Pantocsek. Plate 5, fig. 1.

Fossil Baccil. Ungarns pl. 8, fig. 68.

Valve broad elliptical or orbicular. Upper valve with a rhomboidal or orbicular central area. Length, 0.054 millimeter; breadth, 0.014 millimeter. Geographic distribution: Ceylon, California, Japan (fossil). Sample 3.

COCCONEIS HETEROIDEA Hantsch. Plate 5, fig. 2; Plate 6, fig. 29.

A. SCHMIDT, Atlas Diatom. pl. 196, figs. 2, 33–37, 40, 41.

Valve broadly elliptical. Length, 0.027 to 0.085 millimeter; breadth, 0.018 to 0.069 millimeter. Geographic distribution: Seychelles, Madagascar, Mauritius, Nicobar Islands, Singapore, Japan, China, Sandwich Islands, Samoa, West Indies, Colon. Sample 1.

PINNULARIA QUADRATAREA A. Schmidt var. UNDULATA var. nov. Plate 5, fig. 5.

Valve linear, with subcuneate ends. The middle part of the valve slightly undulate. Length, 0.06 millimeter; breadth. 0.0085 millimeter. Striæ 10 in 0.01 millimeter. Sample 3.

PINNULARIA CLAVICULUS Gregory var. JAPONICA var. nov. Plate 6, fig. 13.

Valve linear, slightly constricted, dividing the valve into three segments. The constriction in the middle part small. Length, 0.062 millimeter; breadth, 0.011 millimeter. Striæ 8 in 0.01 millimeter. Geographic distribution: Typical *P. claviculus* is found in North Sea, Sweden, Balearic Islands, Java, and fossil in Hungary. Sample 3.

NAVICULA LYRA Ehrenberg var. SUBELLIPTICA Cleve forma. Plate 6, fig. 12.

Valve elliptical, not rostrate. Length, 0.035 to 0.04 millimeter; breadth, 0.022 millimeter. Striæ 10 to 12 in 0.01 millimeter. Geographic distribution: Spitzbergen, Finmark, North Sea, Japan, Philippines, fossil in Hungary and California. Sample 1.

NAVICULA LYRA Ehrenberg var. ELLIPTICA A. Schmidt.

Valve elliptical with subrostrate ends. Length, 0.059 to 0.06 millimeter; breadth, 0.023 to 0.025 millimeter. Striæ 10 in 0.01 millimeter. Geographic distribution: North, Mediterranean, and Red Seas, Ceylon, Madagascar, Sumatra, Philippines. Sample 1.

NAVICULA LYRA Ehrenberg var. SUBTYPICA A. Schmidt.

A. SCHMIDT, Atlas Diatom. pl. 2, fig. 24.

Valve elliptical, with parallel margins. Length, 0.072 millimeter; breadth, 0.034 millimeter. Striæ 12 in 0.01 millimeter.

Geographic distribution: North and Mediterranean Seas. Sample 1.

NAVICULA LYRA Ehrenberg var. INTERMEDIA Peragallo. Plate 5, fig. 9.

PERAGALLO, Diatom Mar. France pl. 23, figs. 6, 7.

Length, 0.076 to 0.085 millimeter; breadth, 0.037 to 0.04 millimeter. Striæ 12 in 0.01 millimeter. Geographic distribution: North and Mediterranean Seas. Sample 3.

NAVICULA FORCIPATA Greville var. DENSESTRIATA A. Schmidt. Plate 5, fig. 6.

A. SCHMIDT, Atlas Diatom. pl. 70, figs. 12–16; Nord Sea Diatom. pl. 1, fig. 44.

Valve elliptical, elongate. Length, 0.051 millimeter; breadth, 0.015 millimeter. Striæ 12 in 0.01 millimeter. Geographic distribution: North Sea, Corsica, Cape of Good Hope, Java, Japan, Campeche Bank. Samples 2 and 7.

NAVICULA DIRECTA W. Smith var. GENUINA Cleve.

A. SCHMIDT, Atlas Diatom. pl. 46, figs. 4, 5.

Valve linear-lanceolate, gradually tapering from the middle to the acute ends. Length, 0.068 to 0.105 millimeter; breadth, 0.0068 to 0.01 millimeter. Striæ 7 to 10 in 0.01 millimeter. Geographic distribution: Arctic and North Seas. Samples 1 and 3.

NAVICULA VIRIDULA Kützing var. ROSTELLATA Kützing.

V. HEURCK, Synopsis 84, pl. 7, fig. 24.

Valve lanceolate. Length, 0.03 millimeter; breadth, 0.005 millimeter. Striæ 12 in 0.01 millimeter. Geographic distribution: England, Belgium, Japan. Sample 5.

NAVICULA VIRIDULA Kützing var. JAPONICA var. nov. Plate 6, fig. 16.

Valve lanceolate, gradually tapering from the middle to the obtuse ends. Length, 0.03 millimeter; breadth, 0.0051 millimeter. Striæ 15 in 0.01 millimeter. A variety closely related to var. *slesvicensis* Grunow. Sample 4.

NAVICULA ARENARIA Donkin var. ARCUATA Peragallo.

PERAGALLO, Diatom. Mar. France 101, pl. 13, figs. 4, 6.

Valve lanceolate, slightly constricted in the middle. Length, 0.044 millimeter; breadth, 0.0052 millimeter. Striæ 12 in 0.01 millimeter. Geographic distribution: France, England. Sample 5.

NAVICULA SALINARUM Grunow.

V. HEURCK, Synopsis 82, pl. 8, fig. 9.

Valve elliptic-lanceolate with protracted ends. Length, 0.032 millimeter; breadth, 0.009 millimeter. Striæ 12 in 0.01 millimeter. Geographic distribution: Spitzbergen, Sea of Kara, Finmark, Sweden, Belgium, England, Hungary (fossil). Sample 3.

NAVICULA VLADIVOSTOKENSIS sp. nov. Plate 6, fig. 17.

Valve elliptic-lanceolate, flat. Length, 0.0306 to 0.033 millimeter; breadth, 0.014 to 0.0016 millimeter. Axial area very narrow. Central area small, rounded. Median line ending close to the margin. Striæ very thin. Sample 3.

NAVICULA GRANULATA Bailey.

A. SCHMIDT, Atlas Diatom. pl. 6, figs. 26, 27.

Valve elliptic-lanceolate. Length, 0.061 millimeter; breadth, 0.03 millimeter. Striæ 10 in 0.01 millimeter, slightly radiate throughout. Geographic distribution: North, Mediterranean, and Yellow Seas, Ceylon, Sydney, California guano. Sample 3.

NAVICULA HENNEDYI Smith var. NICEAENSIS Peragallo.

PERAGALLO, Diatom. Mar. France 140, pl. 24, fig. 15.

Valve lanceolate with elongate ends. Length, 0.085 to 0.09 millimeter; breadth, 0.037 to 0.042 millimeter. Striæ 9 in 0.01 millimeter. Geographic distribution: Mediterranean Sea. Sample 5.

NAVICULA CANCELLATA Donkin var. RETUSA Brébisson. Plate 6, fig. 18.

CLEVE, Diatom. Vega Expedition pl. 36, figs. 35*a*, *b*.

Valve linear-lanceolate with rounded ends. Length, 0.056 to 0.06 millimeter; breadth, 0.009 millimeter. Axial area narrow, central broad. Median line straight. Striæ robust, 6.5 in 0.01 millimeter. Geographic distribution: Spitzbergen, North and Baltic Seas, Cape Deschneff. Sample 3.

NAVICULA DISTANS W. Smith.

CLEVE and GRUNOW, Arct. Diatom. pl. 11, fig. 42.

Valve lanceolate, gradually tapering to the ends. Length, 0.01 to 0.012 millimeter; breadth, 0.014 to 0.016 millimeter. Striæ 4.5 in 0.01 millimeter. Geographic distribution: Franz Josef Land, Spitzbergen, Finmark, Greenland, North Sea. Sample 3.

NAVICULA (SCHIZONEMA) RAMOSISSIMA Agardh.

PERAGALLO, Diatom. Mar. France pl. 12, fig. 10.

Valve linear-lanceolate with obtuse ends. Length, 0.04 millimeter; breadth, 0.006 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Canada, Japan, North, Caspian, and Yellow Seas. Sample 4.

NAVICULA (SCHIZONEMA) RAMOSISSIMA Agardh forma AMPLIA Grunow.

V. HEURCK, Synopsis pl. 15, fig. 3.

Valve linear-lanceolate, with obtuse ends. Length, 0.062 to 0.077 millimeter; breadth, 0.008 to 0.011 millimeter. Striæ parallel, finely lineate, 9 to 10 in 0.01 millimeter. Geographic distribution: North Sea, Canada, Mauritius. Sample 2.

NAVICULA (SCHIZONEMA) GREVILLEI Agardh. Plate 5, fig. 8.

V. HEURCK, Synopsis 110, pl. 16, fig. 2; = *N. halophila* var. *brevis* SKVORTZOW in Marin. Diatom. Dairen 423, fig. 24.

Valve rhombic-lanceolate with obtuse ends. Length, 0.045 millimeter; breadth, 0.013 millimeter. Striæ 20 in 0.01 millimeter. Geographic distribution: Spitzbergen, Finmark, coasts of England, Arctic Greenland, Cape Deschneff, West Indies, Kerguelen Land, North and Yellow Seas, California. Samples 1, 3, and 6.

DIPLONEIS BOMBUS Ehrenberg var. EGENA A. Schmidt.

A. SCHMIDT, Atlas Diatom. pl. 13, fig. 10.

Length, 0.035 millimeter; breadth, 0.015 millimeter. Striæ 10 in 0.01 millimeter. Geographic distribution: Balearic Islands, Madagascar, Manila, China, Japan. Sample 3.

DIPLONEIS PRISCA A. Schmidt var. ORIENTALIS var. nov. Plate 5, fig. 11.

Valve elliptical, very sligthly constricted in the middle, with broad rounded ends. Length, 0.047 to 0.057 millimeter; breadth, 0.0187 millimeter. Central nodule broad, quadrate. Costæ 6 in 0.01 millimeter. Samples 3 and 4.

DIPLONEIS FUSCA Gregory. Plate 5, fig. 13.

A. SCHMIDT, Atlas Diatom. pl. 7, fig. 4.

Valve elliptical. Length, 0.069 millimeter; breadth, 0.037 millimeter. Striæ 6 in 0.01 millimeter. Geographic distribution: Campeche Bay, Adriatic and North Seas, Sumatra, Balearic Islands, Hungary (fossil). Sample 3.

DIPLONEIS FUSCA Gregory var. NORVEGICA Cleve forma MINOR f. nov.

Valve elliptical with subrostrate ends and parallel margins. Length, 0.035 millimeter; breadth, 0.013 millimeter. Striæ 10

in 0.01 millimeter. Geographic distribution: The typical var. *norvegica* is found in North Sea and in Hungary (fossil). Sample 3.

DIPLONEIS FUSCA Gregory var. SUBRECTANGULARIS Cleve.

Valve rectangular. Length, 0.037 millimeter; breadth, 0.015 millimeter. Striæ 9 in 0.01 millimeter. Geographic distribution: North Sea, Balearic Islands, Sumatra. Sample 2.

DIPLONEIS SMITHII Brébisson. Plate 5, fig. 14.

A. SCHMIDT, Atlas Diatom. pl. 7, figs. 16, 17.

Valve elliptical. Length, 0.035 to 0.06 millimeter; breadth, 0.015 to 0.02 millimeter. Striæ 10 to 12 in 0.01 millimeter. Geographic distribution: A cosmopolitan diatom. Sample 2.

DIPLONEIS MAJOR Cleve. Plate 5, fig. 12.

A. SCHMIDT, Atlas Diatom. pl. 7, fig. 18.

Valve rhombic-elliptical. Length, 0.047 millimeter; breadth, 0.045 millimeter. Striæ 6 in 0.01 millimeter. Geographic distribution: North Sea, Morocco, Barcelona, Madagascar, Macassar Strait, Sumatra, China, Japan, Australia, Santa Monica, California (fossil). Sample 6.

DIPLONEIS MAJOR Cleve var. SUBCONSTRICTA var. nov. Plate 3, fig. 8.

Valve slightly constricted in the middle part. Length, 0.045 millimeter; breadth, 0.02 millimeter. Costæ 8 in 0.01 millimeter. Sample 3.

DIPLONEIS BOREALIS Grunow. Plate 5, fig. 4.

GRUNOW, Franz Josef Land Diatom. 56, pl. 1, fig. 40.

Valve robust, elongate, with rounded ends. Length, 0.047 to 0.073 millimeter; breadth, 0.02 to 0.02 millimeter. Striæ 8 to 12 in 0.01 millimeter. Geographic distribution: Franz Josef Land, Sea of Kara, Java. Sample 3.

DIPLONEIS INSCRIPTA Cleve var. JAPONICA var. nov. Plate 6, fig. 19.

Valve lanceolate, convex and acute. Length, 0.028 to 0.032 millimeter; breadth, 0.01 to 0.013 millimeter. Central pores approximate, incrassate. Striæ 18 to 20 in 0.01 millimeter, parallel. Geographic distribution: *Diploneis inscripta* is known from the Gulf of Naples and China Sea. Sample 3.

DIPLONEIS CAMPYLODISCUS Grunow.

A. SCHMIDT, Atlas Diatom. pl. 8, figs. 9–11, 12; pl. 70, figs. 64, 65.

Valve suborbicular. Length, 0.032 millimeter; breadth, 0.03 millimeter. Costæ 5 to 6 in 0.01 millimeter. Geographic dis-

tribution: Bab el Mandeb, Seychelles, Madagascar, Philippines, Tahiti, Galapagos Islands, Cape Horn, Campeche Bay. Sample 1.

STAURONEIS SALINA W. Smith.

PERAGALLO, Diatom. Mar. France pl. 7, fig. 22.

Valve lanceolate, with parallel margins and subacute ends. Stauros narrow. Length, 0.037 millimeter; breadth, 0.012 millimeter. Striæ 18 in 0.01 millimeter. Geographic distribution: North, Mediterranean, and Black Seas. Sample 4.

STAURONEIS VLADIVOSTOKENSIS sp. nov. Plate 6, figs. 20–21.

Valve elliptic-lanceolate, with obtuse ends. Length, 0.03 to 0.034 millimeter; breadth, 0.01 to 0.012 millimeter. Stauros narrower towards the margins. Striæ not seen. This peculiar species has some resemblance to *S. kryophila* Grunow in Franz Josef Land Diatom. 105, pl. 1, fig. 47. Sample 4.

CALONEIS LIBER W. Smith var. GENUINA Cleve.

A. SCHMIDT, Atlas Diatom. pl. 50, figs. 19–21, 37.

Valve linear, with slightly convex margins. Length, 0.062 millimeter; breadth, 0.012 millimeter. Striæ 22 in 0.01 millimeter. Geographic distribution: Greenland, Spitzbergen, Finmark, Bering Island, North, Mediterranean, and Yellow Seas, Ceylon, Sidney, Tasmania, Philippines, Japan, Campeche Bay. Sample 6.

CALONEIS LIBER W. Smith var. LINEARIS Grunow.

A. SCHMIDT, Atlas Diatom. pl. 50, figs. 38, 40.

Valve linear, narrow, with parallel margins. Length, 0.042 to 0.059 millimeter; breadth, 0.0085 to 0.011 millimeter. Striæ 17 in 0.01 millimeter. Geographic distribution: Atlantic coasts of Europe, Africa, and America, Peru, Honduras, Gulf of Mexico, Yellow Sea. Samples 1 and 6.

TRACHYNEIS ASPERA Ehrenberg var. GENUINA Cleve. Plate 5, fig. 7.

Valve linear-lanceolate with obtuse ends. Length, 0.111 millimeter; breadth, 0.0204 millimeter. Striæ 9 in 0.01 millimeter. Geographic distribution: Arctic America, North Sea, Cape of Good Hope, New Zealand, Samoa, New Caledonia, Java, Galapagos Islands, Sea of Japan, Vladivostok. Sample 1.

TRACHYNEIS ASPERA Ehrenberg var. MINUTA Peragallo.

PERAGALLO, Diatom. Mar. France 150–151, pl. 29, fig. 7.

Valve minute, elongate, obtuse. Length, 0.0024 millimeter; breadth, 0.011 millimeter. Striæ 18 in 0.01 millimeter. Geographic distribution: France. Sample 1.

TRACHYNEIS ASPERA Ehrenberg var. CONTERMINA A. Schmidt.

A. SCHMIDT, Atlas Diatom. pl. 48, figs. 17–18.

Valve narrow elliptical, with obtuse ends. Length, 0.054 millimeter; breadth, 0.013 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Sea of Japan, Cape Horn. Sample 6.

FRUSTULIA INTERPOSITA Lewis.

LEWIS, Proc. Acad. Nat. Sci. Phila. (1865) pl. 11, fig. 19.

Valve linear-elliptical, with broad, rounded ends. Length, 0.107 millimeter; breadth, 0.02 to 0.023 millimeter. Transverse striæ 25 in 0.01 millimeter. Geographic distribution: Brackish water. Sierra Leone, Bombay, California, South America, Black Sea, Hungary (fossil). Sample 6.

MASTOGLOIA ELLIPTICA Agardh.

V. HEURCK, Synopsis pl. 4, fig. 19.

Valve elliptical. Length, 0.025 millimeter; breadth, 0.012 millimeter. Striæ 18 in 0.01 millimeter. Geographic distribution: Brackish waters of Sweden, England, Belgium, and Ecuador. Sample 5.

PLEUROSIGMA ELONGATUM W. Smith var. KARIANA Grunow.

PERAGALLO, Monogr. Pleurosigma pl. 2, fig. 4.

Valves slightly sigmoid, elongated. Ends acute. Length, 0.139 millimeter; breadth, 0.015 millimeter. Transverse and oblique striæ 24/23 in 0.01 millimeter. Geographic distribution: Sea of Kara, Yellow Sea, Dairen. Sample 6.

PLEUROSIGMA SUBRIGIDUM Grunow.

PERAGALLO, Monogr. Pleurosigma pl. 2, fig. 3.

Valve linear, sigmoid, with obtuse ends. Length, 0.053 millimeter; breadth, 0.018 millimeter. Geographic distribution: North and Mediterranean Seas, Sumatra. Sample 5.

PLEUROSIGMA FORMOSUM W. Smith.

PERAGALLO, Monogr. Pleurosigma pl. 1, figs. 11–13.

Valve narrow, linear-lanceolate, sigmoid. Length, 0.2 to 0.46 millimeter; breadth, 0.02 to 0.05 millimeter. Geographic distribution: North, Mediterranean, Red, and Yellow Seas, Java, China, Bering Island, Sandwich Islands, Galapagos Islands, West Indies, Philippines, Dairen. Samples 3 and 5.

PLEUROSIGMA FORMOSUM W. Smith var. ORIENTALIS var. nov. Plate 6, fig. 30.

Valve narrow, slightly sigmoid. Length, 0.2 millimeter; breadth, 0.019 millimeter. Transverse and oblique striæ 27/25 in 0.01 millimeter. Sample 3.

PLEUROSIGMA SPECIOSUM W. Smith.

PERAGALLO, Monogr. Pleurosigma pl. 2, figs. 15–16.

Valve linear, with unilaterally rounded ends. Length, 0.27 millimeter; breadth, 0.03 millimeter. Geographic distribution: North, Mediterranean, and Red Seas, Java, Sumatra, Labuan, China, Port Jackson, Barbados. Sample 1.

PLEUROSIGMA NUBICULA W. Smith.

PERAGALLO, Monogr. Pleurosigma pl. 5, fig. 26.

Valve narrow-lanceolate, with subacute ends. Length, 0.119 millimeter; breadth, 0.017 millimeter. Transverse and oblique striæ 21 to 22 in 0.01 millimeter. Geographic distribution: Finmark, North and Adriatic Seas, Sumatra, California. Sample 1.

GYROSIGMA DISTORTUM W. Smith var. PARKERI Harrison.

PERAGALLO, Monogr. Pleurosigma pl. 8, fig. 33.

Valve lanceolate, sigmoid. Length, 0.105 millimeter; breadth, 0.0204 millimeter. Geographic distribution: England, Belgium, Baltic and Yellow Seas, Dairen. Sample 5.

PLEUROSIGMA SPENSERII W. Smith.

Valve linear-lanceolate, sigmoid, obtuse. Length, 0.093 millimeter; breadth, 0.014 millimeter. Geographic distribution: Brackish water. Spitzbergen, Sea of Kara, North Sea, Saxony, Canada, New York, West Indies, Bombay. Sample 4.

RHOICONEIS GARKEANA Grunow var. JAPONICA var. nov. Plate 6, figs. 22, 23.

Valve linear, with obtuse ends. Length, 0.04 to 0.064 millimeter; breadth, 0.01 to 0.013 millimeter. Striæ 18 in 0.01 millimeter. Geographic distribution: Typical *R. garkeana* is found in Bering Strait, Kamortha, California, North Pacific Ocean. Sample 1.

RHOICONEIS SIBIRICA Grunow.

Valve lanceolate and subacute. Length, 0.069 to 0.07 millimeter; breadth, 0.011 to 0.012 millimeter. Striæ almost parallel. Geographic distribution: Siberian Sea, Cape Wankarema. Sample 3.

RHOICOSPHENIA CURVATA Kützing.

A. SCHMIDT, Atlas Diatom. pl. 213, figs. 6, 7.

Valve clavate, with obtuse ends. Length, 0.042 millimeter; breadth, 0.0068 millimeter. Geographic distribution: Fresh and brackish waters. Baltic and Caspian Seas, Atlantic coasts of Europe and America, New Zealand, Saint Paul Island, Honduras. Sample 1.

RHOICOSPHENIA MARINA W. Smith var. JAPONICA Skvortzow.

Some Marin. Diatom. Siber. Shore (1929) 59, fig. 8.

Valve attenuate, clavate with rounded, obtuse upper ends and more narrow attenuated obtuse base. Length, 0.045 to 0.062 millimeter; breadth, 0.006 to 0.008 millimeter. Striæ 18 in 0.01 millimeter. Geographic distribution: Sea of Japan. Samples 1 and 6.

AMPHORA PROTEUS Gregory.

PERAGALLO, Diatom. Mar. France pl. 44, fig. 26.

Length, 0.039 millimeter; breadth, 0.0187 millimeter. Striæ 11 in 0.01 millimeter. Geographic distribution: Greenland, Spitzbergen, Finmark, Sea of Kara, Cape Deschneff, St. Helena, Campeche Bay, North, Mediterranean, Black, and Yellow Seas, Seychelles, China, Galapagos Islands, Dairen. Sample 3.

AMPHORA EUNOTIA Cleve var. JAPONICA var. nov. Plate 6, fig. 24.

Valve slightly curved. Length, 0.059 millimeter; breadth, 0.011 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Typical *A. eunotia* is known from Greenland, Spitzbergen, Bohuslan, Bab el Mandeb, Labuan. Sample 3.

AMPHORA ACUTA Gregory var. JAPONICA var. nov. Plate 6, fig. 25.

Valve lunate, with arcuate dorsal margin, slightly curved ventral side and with apiculate ends. Length, 0.073 millimeter; breadth, 0.011 millimeter. Striæ 9 in 0.01 millimeter. Ventral side striated. Sample 3.

AMPHORA ANGUSTA (Gregory) Cleve var. TYPICA Cleve forma DEPRESSA f. nov.

Valve narrow, semilanceolate, acute, slightly parallel, with depressed dorsal side. Length, 0.059 to 0.067 millimeter; breadth, 0.09 millimeter. Striæ 5.5 in 0.01 millimeter. Sample 3.

AMPHORA ANGUSTA (Gregory) Cleve var. VENTRICOSA Gregory. Plate 6, fig. 28.

CASTRACANE, Diatom. Challeng. Exped. 21, pl. 27, fig. 8.

Length, 0.079 millimeter; breadth, 0.012 millimeter. Striæ 10 in 0.01 millimeter. Geographic distribution: Greenland, Spitzbergen, Sea of Kara, Finmark, coasts of Scotland, Norway, and Bohuslan, Adriatic Sea, Bab el Mandeb, Monterey. Sample 3.

AMPHORA ANGUSTA (Gregory) Cleve var. TYPICA Cleve.

A. SCHMIDT, Atlas Diatom. pl. 25, fig. 15.

Length, 0.042 to 0.062 millimeter; breadth, 0.007 to 0.0085 millimeter. Striæ 15 to 18 in 0.01 millimeter. Geographic dis-

tribution: Scotland, Spitzbergen, Sea of Kara, Quicy, Massachusetts, Jamaica, Yellow Sea, Philippines, Hungary (fossil). Samples 5 and 6.

AMPHORA CRASSA Gregory. Plate 5, fig. 10.

A. SCHMIDT, Atlas Diatom. pl. 28, figs. 30–33.

Valve linear, with incurved ends. Length, 0.068 millimeter; breadth, 0.009 millimeter. Striæ 4.5 in 0.01 millimeter. Geographic distribution: Greenland, Spitzbergen, North Mediterranean, and Adriatic Seas, Sumatra, China, Philippines, Hungary (fossil). Sample 3.

AMPHORA MEXICANA A. Schmidt var. MINOR var. nov. Plate 6, fig. 26.

Valve lunate, with arcuate dorsal and straight ventral margins. Length, 0.074 millimeter; breadth, 0.01 millimeter. Median line biarcuate. Striæ 15 in 0.01 millimeter. Sample 3.

AMPHORA TURGIDA Gregory.

A. SCHMIDT, Atlas Diatom. pl. 25, figs. 24, 25.

Length, 0.042 millimeter; breadth, 0.014 millimeter. Striæ 7 in 0.01 millimeter. Geographic distribution: Scotland, Norway, Red Sea, Java, Macassar Strait, Labuan, Philippines. Sample 3.

AMPHORA OCELLATA Donkin var. HYALINA var. nov. Plate 6, fig. 27.

Valve linear. Central nodule on the dorsal side dilated into a stauros. Terminal fissures small. Length, 0.051 millimeter; breadth, 0.006 millimeter. Striæ very thin, 28 in 0.01 millimeter. Sample 3.

RHOPALODIA MUSCULUS Kützing.

PERAGALLO, Diatom. Mar. France pl. 77, figs. 6–8, 10.

Length, 0.034 to 0.037 millimeter. Geographic distribution: Brackish and marine waters. Sample 5.

NITSCHIA VITREA Norm.

V. HEURCK, Synopsis 181, pl. 67, figs. 10, 11.

Length, 0.093 millimeter; breadth, 0.0065 millimeter. Coarse dorsal lines 7 to 8 in 0.01 millimeter. Fine lines 25 in 0.01 millimeter. Geographic distribution: Brackish waters. North Sea. Sample 5.

NITSCHIA GRANULATA Grunow.

V. HEURCK, Synopsis pl. 57, fig. 5.

Length, 0.0185 millimeter; breadth, 0.01 millimeter. Geographic distribution: A cosmopolitan diatom. Sample 3.

NITSCHIA PUNCTATA Smith var. COARCTATA Grunow.

PERAGALLO, Diatom. Mar. France pl. 69, figs. 26–30.

Length, 0.035 millimeter; breadth, 0.013 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, Yellow Sea. Sample 6.

NITSCHIA LORENZIANA Grunow.

V. HEURCK, Synopsis 185, pl. 70, fig. 12.

Length, 0.24 millimeter; breadth, 0.008 millimeter. Geographic distribution: Adriatic and North Seas. Sample 6.

NITSCHIA BILOBATA Smith var. MINOR Grunow.

V. HEURCK, Synopsis, pl. 60, figs. 2, 3.

Length, 0.047 millimeter; breadth, 0.013 millimeter. Fine lines 15 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Sample 1.

NITSCHIA JAPONICA sp. nov. Plate 6, fig. 6.

Valve lanceolate-linear, with slightly elongated and rounded ends. Length, 0.1 to 0.01 millimeter; breadth, 0.01 millimeter. Coarse dorsal lines 2.5 to 3 in 0.01 millimeter. Fine lines 28 in 0.01 millimeter. Sample 3.

NITSCHIA ANGULARIS W. Smith.

V. HEURCK, Synopsis pl. 62, figs. 11–14.

Length, 0.115 to 0.2 millimeter; breadth, 0.018 millimeter. Coarse dorsal lines 7 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, North America, Alaska. Sample 6.

NITSCHIA SIGMA Kützing var. HABIRSHAWII Febiger.

V. HEURCK, Synopsis pl. 66, fig. 4.

Length, 0.35 millimeter; breadth, 0.01 millimeter. Fine lines 27 in 0.01 millimeter. Coarse dorsal lines 7 in 0.01 millimeter. Geographic distribution: North Sea, Mediterranean Sea, Yellow Sea, Dairen. Sample 1.

NITSCHIA LONGISSIMA (Brébisson) Ralfs.

A. SCHMIDT, Atlas Diatom. pl. 335, fig. 2.

Length, 0.37 to 0.39 millimeter; breadth, 0.0068 millimeter. Geographic distribution: A cosmopolitan diatom. Sample 5.

NITSCHIA ACUMINATA Smith.

V. HEURCK, Synopsis 173, pl. 58, figs. 16, 17.

Length, 0.037 millimeter; breadth, 0.005 millimeter. Fine lines 15 in 0.01 millimeter. Geographic distribution: North

America, Mediterranean and North Seas, Japan (fossil). Sample 5.

NITSCHIA APICULATA Gregory.

V. HEURCK, Synopsis pl. 58, figs. 26–27.

Valves with rostrate ends. Length, 0.059 millimeter; breadth, 0.01 millimeter. Fine lines 15 in 0.01 millimeter. Geographic distribution: North America, Mediterranean Sea. Sample 5.

NITSCHIA PANDURIFORMIS Gregory.

V. HEURCK, Synopsis pl. 58, figs. 1–3.

Valve panduriform. Length, 0.051 to 0.056 millimeter; breadth, 0.01 to 0.015 millimeter. Fine lines 25 in 0.01 millimeter. Coarse dorsal lines 10 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, North, Mediterranean, and Yellow Seas, Philippines. Samples 2 and 3.

NITZCHIELLA CLOSTERIUM W. Smith.

SMITH, Brit. Diatom. pl. 15, fig. 120.

Valves linear-lanceolate, with long horns or beaks, curved in the one side. Length, 0.085 to 0.095 millimeter. Geographic distribution: Atlantic and Pacific Oceans. Sample 4.

GOMPHONITZSCHIA UNGERI Grunow. Plate 3, fig. 3.

Length, 0.022 to 0.034 millimeter; breadth, 0.0034 millimeter. Striæ 22 in 0.01 millimeter. Geographic distribution: Brackish waters of Egypt. Sample 1.

SURIRELLA OVALIS Brébisson.

V. HEURCK, Synopsis pl. 73, figs. 5–7.

Length, 0.03 millimeter; breadth, 0.017 millimeter. Geographic distribution: Fresh and brackish waters. A cosmopolitan diatom. Sample 5.

SURIRELLA FASTUOSA Ehrenberg var. CUNEATA Grunow.

A. SCHMIDT, Atlas Diatom. pl. 4, figs. 1, 2.

Length, 0.072 to 0.08 millimeter; breadth, 0.045 to 0.054 millimeter. Geographic distribution: A cosmopolitan marine diatom. Samples 1 and 6.

CAMPYLODISCUS SAMOENSIS Grunow.

A. SCHMIDT, Atlas Diatom. pl. 15, figs. 13, 15, 18, 20.

Diameter of the valve 0.102 millimeter. Costæ 3 to 4 in 0.01 millimeter. Geographic distribution: Mediterranean and Yellow Seas, Pacific Ocean, Philippines. Sample 1.

ILLUSTRATIONS

Plate 1

Fig. 1. *Hyalodiscus ambiguus* Grunow.
Figs. 2 and 3. *Stephanopyxis turris* (Greville and Arn.) Ralfs var. *intermedia* Grunow.
4 and 5. *Cyclotella striata* (Kützing) Grunow var. *ambigua* Grunow.
6 to 9. *Cyclotella striata* (Kützing) Grunow.

Plate 2

Fig. 1. *Coscinodiscus marginatus* Ehrenberg.
Figs. 2 to 4. *Coscinodiscus radiatus* Ehrenberg.
5 and 6. *Coscinodiscus denarius* A. Schmidt.
Fig. 7. *Coscinodiscus curvatulus* Grunow var. *japonica* var. nov.
8. *Coscinodiscus lineatus* Ehrenberg.
9. *Coscinodiscus curvatulus* Grunow var. *minor* (Ehrenberg) Grunow.

Plate 3

Fig. 1. *Actinoptychus undulatus* (Bailey) Ralfs.
2. *Coscinodiscus excentricus* Ehrenberg.
3. *Gomphonitzschia ungeri* Grunow.
4. *Asteromphalus heptactis* (Brébisson) Ralfs.
5. *Aulacodiscus amoenus* Greville.
6. *Auliscus coelatus* Bailey var. *strigillata* A. Schmidt.
7. *Cocconeis scutellum* Ehrenberg var. *japonica* Skvortzow.
8. *Diploneis major* Cleve var. *subconstricta* var. nov.
9. *Biddulphia aurita* Brébisson.
10. *Cocconeis dirupta* Gregory var. *antarctica* Grunow.
11. *Cocconeis scutellum* Ehrenberg var. *ornata* Grunow.

Plate 4

Figs. 1 to 8. *Cocconeis scutellum* Ehrenberg var. *japonica* Skvortzow.

Plate 5

Fig. 1. *Cocconeis dirupta* Gregory var. *sigma* Pantocsek.
2. *Cocconeis heteroidea* Hantsch.
3. *Rhabdonema arcuatum* (Lyngbye) Kützing.
4. *Diploneis borealis* Grunow.
5. *Pinnularia quadratarea* A. Smith var. *undulata* var. nov.
6. *Navicula forcipata* Greville var. *densestriata* A. Smith.
7. *Trachyneis aspera* Ehrenberg var. *genuina* Cleve.
8. *Navicula* (*Schizonema*) *grevillei* Agardh.
9. *Navicula lyra* Ehrenberg var. *intermedia* Peragallo.
10. *Amphora crassa* Gregory.

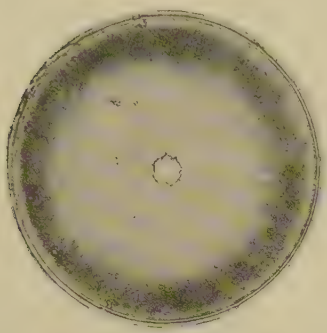
FIG. 11. *Diploneis prisca* A. Smith var. *orientalis* var. nov.
12. *Diploneis major* Cleve.
13. *Diploneis fusca* Gregory.
14. *Diploneis smithii* Brébisson.

PLATE 6

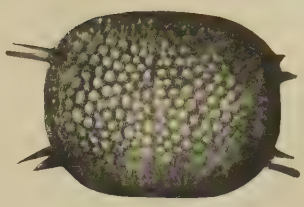
FIG. 1. *Licmophora gracilis* (Kützing) Ehrenberg.
2. *Licmophora communis* (Heib.) Grunow.
3. *Biddulphia aurita* Brébisson.
4. *Biddulphia aurita* Brébisson var. *orientalis* Mereschkovski.
5. *Grammatophora angulosa* Ehrenberg.
6. *Nitschia japonica* sp. nov.
7. *Licmophora lyngbyei* Kützing var. *elongata* Grunow.
8. *Fragilaria oceanica* Cleve var. *acuta* var. nov.
9. *Fragilaria oceanica* Cleve var. *japonica* var. nov.
10. *Biddulphia obtusa* Grunow.
11. *Grammatophora angulosa* Ehrenberg var. *islandica* Ehrenberg.
12. *Navicula lyra* Ehrenberg var. *subelliptica* Cleve forma.
13. *Pinnularia claviculus* Gregory var. *japonica* var. nov.
14. *Synedra affinis* Kützing var. *hybrida* Grunow.
15. *Synedra affinis* Kützing var. *tabulata* Grunow.
16. *Navicula viridula* Kützing var. *japonica* var. nov.
17. *Navicula vladivostokensis* sp. nov.
18. *Navicula cancellata* Donkin var. *retusa* Brébisson.
19. *Diploneis inscripta* Cleve var. *japonica* var. nov.

FIGS. 20 and 21. *Stauroneis vladivostokensis* sp. nov.
22 and 23. *Rhoiconeis garkeana* Grunow var. *japonica* var. nov.

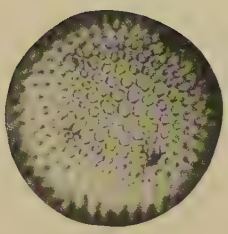
FIG. 24. *Amphora eunotia* Cleve var. *japonica* var. nov.
25. *Amphora acuta* Gregory var. *japonica* var. nov.
26. *Amphora mexicana* A. Smith var. *minor* var. nov.
27. *Amphora ocellata* Donkin var. *hyalina* var. nov.
28. *Amphora angusta* (Gregory) Cleve var. *ventricosa* Gregory.
29. *Cocconeis heteroidea* Hantsch.
30. *Pleurosigma formosum* Smith var. *orientalis* var. nov.



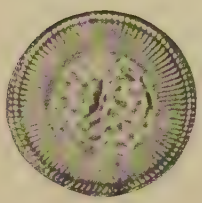
1



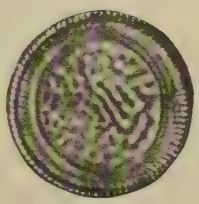
2



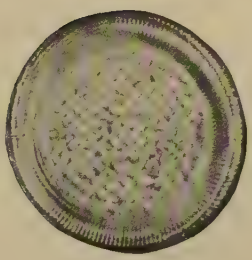
3



4

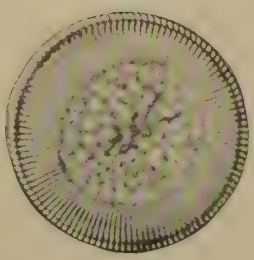


5

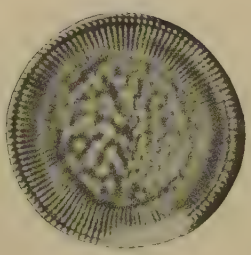


6

7



8



9

PLATE 1.

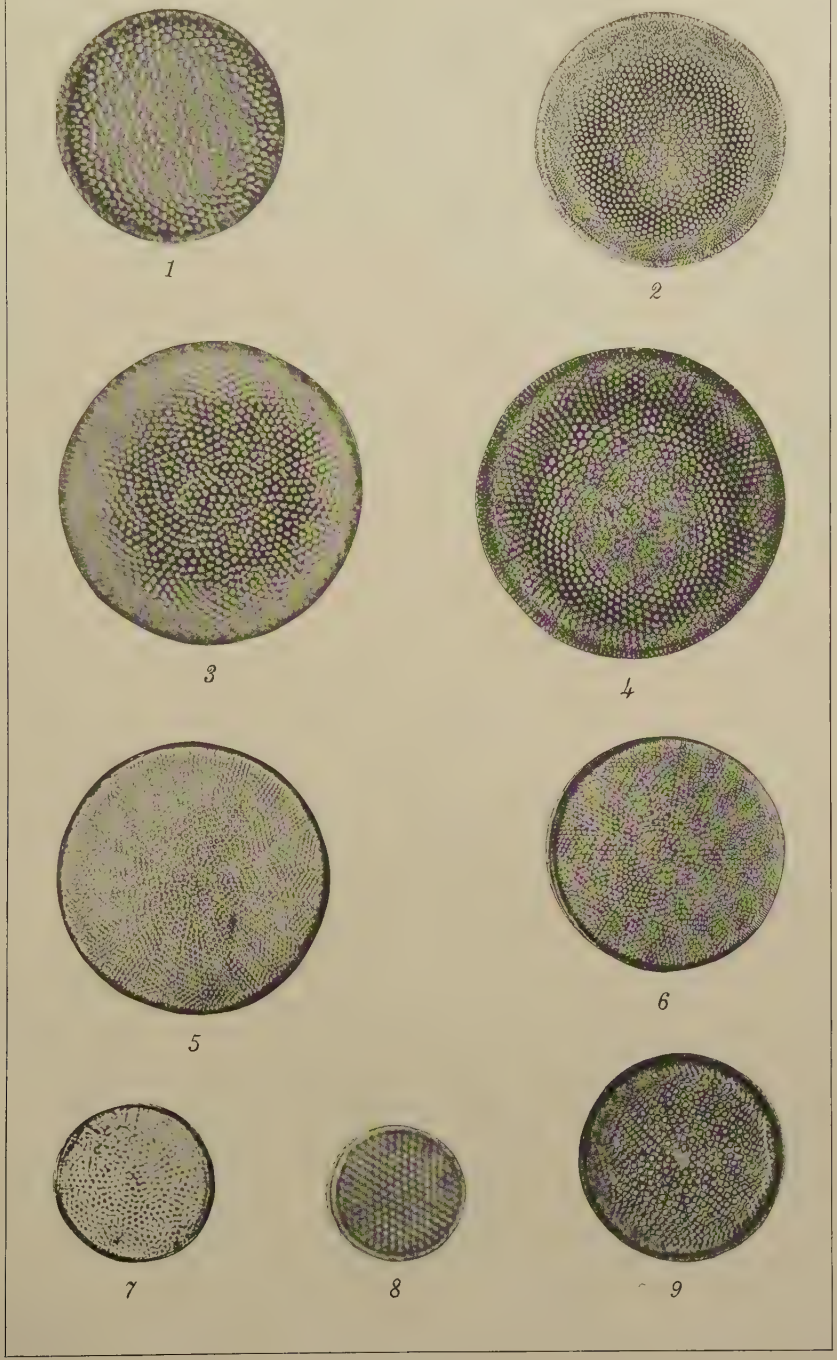
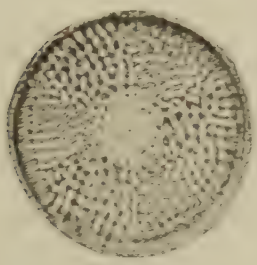
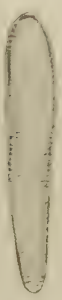


PLATE 2.



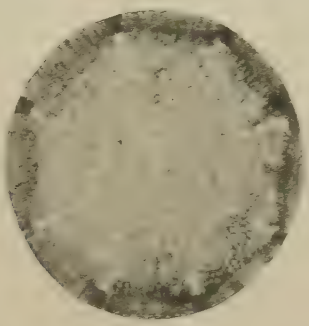
1

2



3

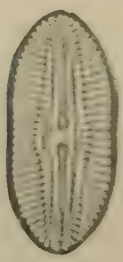
4



5

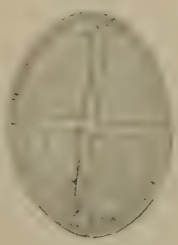
6

7



8

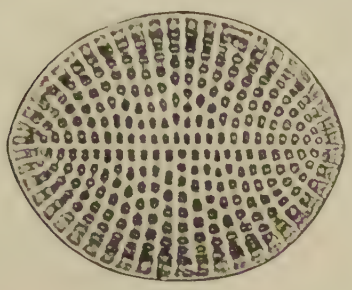
9



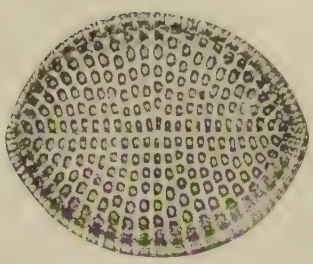
10

11

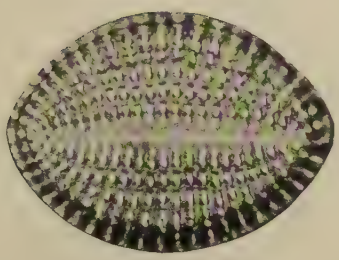
PLATE 3.



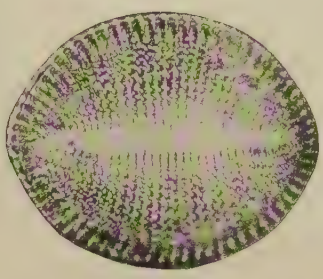
1



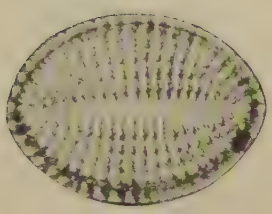
2



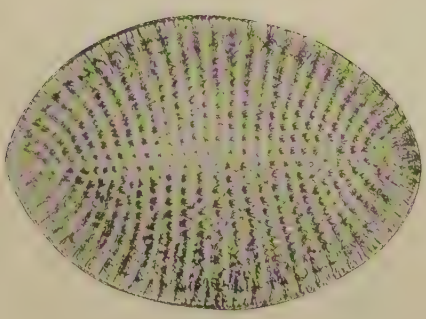
3



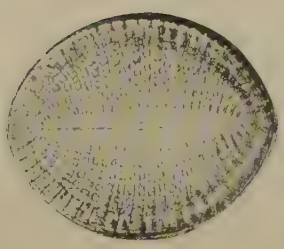
4



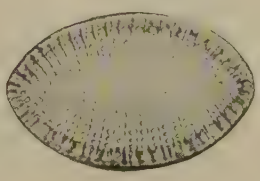
5



6



7



8

PLATE 4.

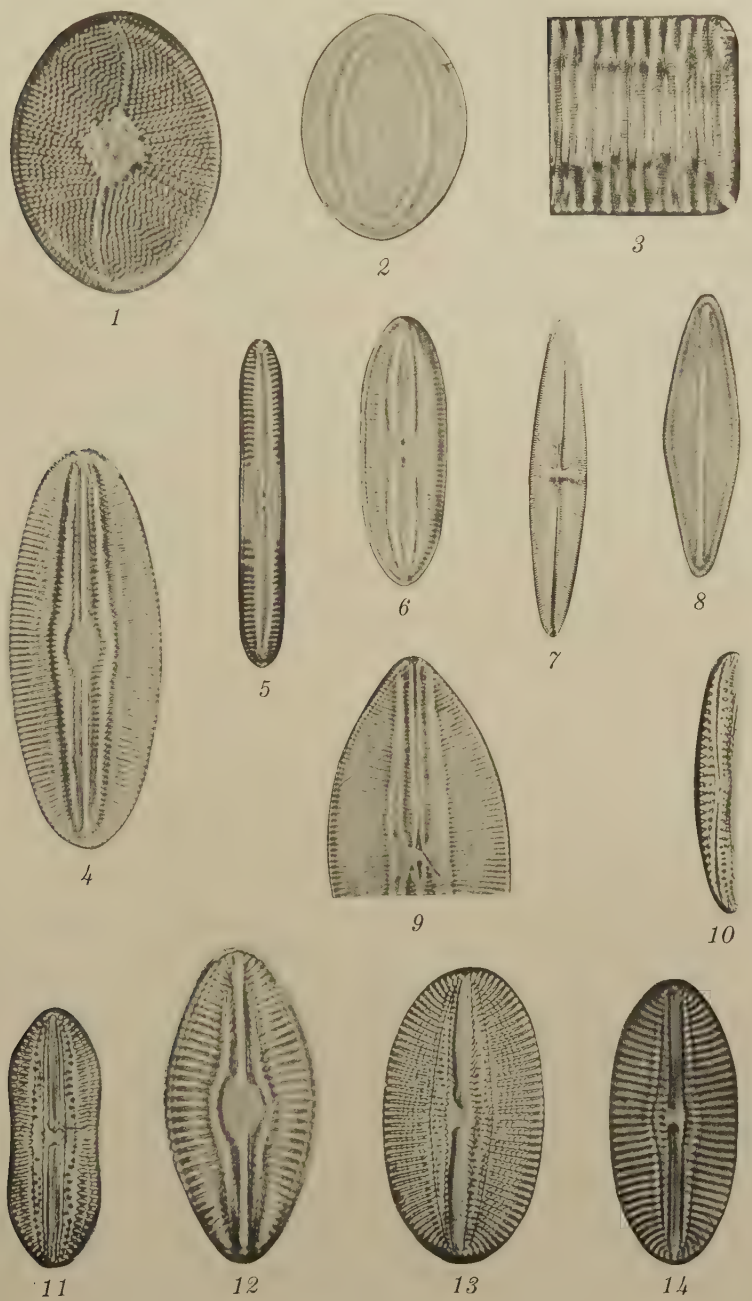


PLATE 5.

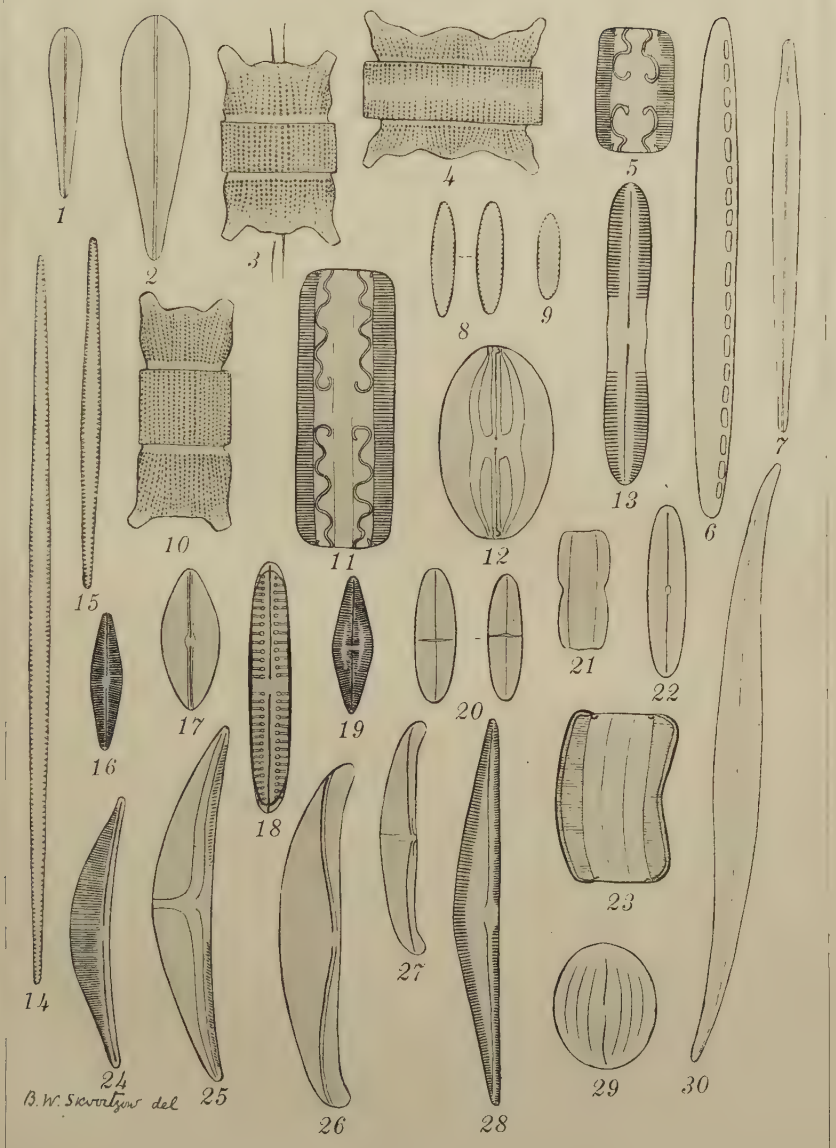

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
B. W. Skvortzow del

PLATE 6.

MARINE DIATOMS FROM FORMOSA STRAIT

By B. W. Skvortzow

Of Harbin, China

THREE PLATES

The material that is reported upon in the following pages was collected by me on the seashore of Fukien Province, near Foochow, China, during the winter of 1918. The material consisted of several samples of marine Cladophoraceæ and Laminariaceæ on the twigs of which I have found quite a number of diatoms. These algæ have been examined from a systematic point of view, and twenty-six genera, including sixty-four species and varieties, were recorded. I am describing ten species and varieties as new. In order to show the geographical significance of the diatoms found at Foochow, reference is given to the previously recorded geographical distribution of each species. These records indicate a very wide range of localities for many of our types, while on the other hand some species are peculiar to the southern part of the Pacific.

MELOSIRA NUMMULOIDES (Dillw.) Agardh.

V. Heurck, Synopsis pl. 85, figs. 1, 2.

Length, 0.017 millimeter; breadth, 0.015 millimeter. Geographic distribution: Atlantic and Pacific Oceans.

MELOSIRA MONILIFORMIS (Müller) Agardh.

V. Heurck, Synopsis pl. 85, figs. 5–7.

Valve brown, dotted. Breadth, 0.048 to 0.05 millimeter. Geographic distribution: Pacific Ocean, North and Mediterranean Seas.

PODOSIRA STELLIGER (Bailey) Mann.

V. Heurck, Synopsis pl. 84, figs. 1–2.

Diameter of the valve 0.068 to 0.07 millimeter. Geographic distribution: Atlantic and Pacific Oceans.

HYALODISCUS AMBIGUUS Grunow.

Peragallo, Diatom. Mar. France pl. 119, fig. 19.

Diameter of the valve 0.15 to 0.17 millimeter. Striæ 22 in 0.01 millimeter. Geographical distribution: North and Mediterranean Seas.

COSCINODISCUS CENTRALIS Ehrenb.

HUSTEDT, F. Die Kiesel algen. Lief. 3, p. 444–45, fig. 243.

Diameter of the valve 0.2 to 0.25 millimeter. Markings 4 to 5 in 0.01 millimeter. Geographic distribution: Pacific and Atlantic Oceans, China, North Sea.

COSCINODISCUS WEYPRECHTI Grunow.

GRUNOW, Diatom. Franz Josef Land 78, pl. C, fig. 8.

Central space minute, with a small rosette. Markings gradually decreasing outwards; towards the center 4.5 to 5, towards the border 5.5 to 6.5, in 0.01 millimeter. Marking with central dot and minute puncta. Border with delicate striæ. Geographic distribution: Franz Josef Land, North Sea.

COSCINODISCUS RADIATUS Ehrenberg.

A. SCHMIDT, Atlas Diatom. pl. 60, figs. 1–6, 9, 10; pl. 61, fig. 13; pl. 65, fig. 8.

Diameter of the valve 0.075 to 0.01 millimeter. Markings 4 to 5 in 0.01 millimeter. Geographic distribution: A cosmopolitan diatom.

COSCINODISCUS DENARIUS Schmidt.

A. SCHMIDT, Atlas Diatom. pl. 57, figs. 19–21.

Diameter of the valve 0.069 to 0.095 millimeter. Markings 6 in 0.01 millimeter. Geographic distribution: Atlantic Ocean.

COSCINODISCUS OCULUS IRIDIS Ehrenberg.

A. SCHMIDT, Atlas Diatom. pl. 63, figs. 6, 7, 9.

Diameter of the valve 0.2 millimeter. Geographic distribution: A cosmopolitan diatom.

COSCINODISCUS EXCENTRICUS Ehrenberg.

A. SCHMIDT, Atlas Diatom. pl. 58, figs. 46–49.

Diameter of the valve 0.068 to 0.075 millimeter. Markings 4 to 5 in 0.01 millimeter. Geographic distribution: Pacific Ocean, North and Yellow Seas, Japan, Philippine Islands.

COSCINODISCUS LINEATUS Ehrenberg.

A. SCHMIDT, Atlas Diatom. pl. 59, figs. 29–31.

Diameter of the valve 0.044 millimeter. Markings 2.5 in 0.01 millimeter. Geographic distribution: A cosmopolitan diatom.

ACTINOPTYCHUS UNDULATUS (Bail.) Ralfs.

V. HEURCK, Synopsis pl. 122, figs. 1, 3.

Diameter of the valve 0.034 to 0.04 millimeter. Geographic distribution: Atlantic and Pacific Oceans.

ACTINOPTYCHUS ANNULATUS (Wallich) Grunow var. MINOR Grunow. Plate 1, fig. 7.

V. HEURCK, Synopsis pl. 124, fig. 13.

Diameter of the valve 0.042 to 0.062 millimeter. Geographic distribution. Pacific Ocean, China.

ACTINOCYCLUS EHRENBERGI Ralfs var. CRASSA (W. Smith) Hustedt.

V. HEURCK, Synopsis pl. 124, figs. 6, 8.

Diameter of the valve 0.057 to 0.085 millimeter. Markings 6 in 0.01 millimeter. Geographic distribution: Pacific Ocean.

ARACHNOIDISCUS ORNATUS Ehrenberg.

A. SCHMIDT, Atlas Diatom. pl. 73, figs. 4–10.

Diameter of the valve 0.04 to 0.085 millimeter. Geographic distribution: Japan, Honshu Islands, Yokohama.

BIDDULPHIA OBTUSA Grunow. Plate 2, figs. 11, 12.

A. SCHMIDT, Atlas Diatom. pl. 122, figs. 31, 30.

Length, 0.025 to 0.06 millimeter; breadth, 0.018 to 0.065 millimeter. Geographic distribution: North Sea, China, New York, Carpentaria Bay.

BIDDULPHIA GRUNDLERI A. Schmidt. Plate 1, fig. 11; Plate 2, figs. 2, 3.

A. SCHMIDT, Atlas Diatom. pl. 118, figs. 22–24.

Length, 0.111 to 0.14 millimeter; breadth, 0.02 to 0.042 millimeter. Geographic distribution: Sea of Japan, China, Philippines, Adriatic Sea.

BIDDULPHIA ARCTICUM (Brightwell) Cleve var. FORMOSA Brightwell. Plate 1, fig. 4.

A. SCHMIDT, Atlas Diatom. pl. 79, fig. 2.

Diameter of the valve 0.07 to 0.08 millimeter; puncta 4 to 6 in 0.01 millimeter. Geographic distribution: North Sea, Sea of Japan, Samoa, Philippine Islands.

BIDDULPHIA CONCAVA Mann. Plate 2, fig. 5.

A. SCHMIDT, Atlas Diatom. pl. 84, fig. 17.

Diameter of the valve 0.073 millimeter. Geographic distribution: Sea of Japan, Philippine Islands.

CYCLOTELLA STYLORUM Brightwell.

V. HEURCK, Synopsis pl. 92, figs. 2-4.

Diameter of the valve 0.042 to 0.05 millimeter. Striæ 9 in 0.01 millimeter. The border markings 4 in 0.01 millimeter. Geographic distribution: North and Mediterranean Seas, Sea of Japan.

CYCLOTELLA STRIATA (Kützing) Grunow var. INTERMEDIA Grunow.

V. HEURCK, Synopsis pl. 92, fig. 10.

Diameter of the valve 0.0198 to 0.02 millimeter. Striæ 12 in 0.01 millimeter. Geographic distribution: North Sea, Pacific Ocean, Sea of Japan.

BACTERIASTRUM HYALINUM Lauder.

IKARI, Bacteriastrum Japan 422, 23, fig. 2.

Valves 0.014 to 0.018 millimeter in breadth. Geographic distribution: Atlantic and Pacific Oceans, Sea of Japan, Korean Strait.

GRAMMATOPHORA ANGULOSA Ehrenberg var. HAMULIFERA Kützing. Plate 2, fig. 7.

V. HEURCK, Synopsis pl. 53, fig. 4.

Length and breadth, 0.017 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans.

GRAMMATOPHORA MARINA (Lyngbye) Kützing var. UNDULATA Ehrenberg.

V. HEURCK, Synopsis pl. 53, fig. 17.

Length, 0.051 to 0.12 millimeter; breadth, 0.017 to 0.025 millimeter. Geographic distribution: Mediterranean and North Seas, Japan, China.

GRAMMATOPHORA MARINA (Lyngbye) Kützing.

V. HEURCK, Synopsis 163, pl. 53, fig. 10.

Length, 0.074 millimeter; breadth, 0.01 millimeter. Geographic distribution: A cosmopolitan diatom.

RHABDONEMA ADRIATICUM Kützing.

A. SCHMIDT, Atlas Diatom. pl. 217, figs. 17–29.

Length, 0.113 to 0.12 millimeter. Geographic distribution: Atlantic Ocean, Mediterranean and Red Seas, Australia.

SYNEDRA ROBUSTA Ralfs var. SINICA var. nov. Plate 1, fig. 9.

Valve lanceolate with rounded ends. Length, 0.17 to 0.19 millimeter; breadth, 0.017 to 0.02 millimeter. Lines 6 in 0.01 millimeter.

RHAPHONEIS ELLIPTICA Castracane.

CASTRACANE, Challenger Diatom. 49, pl. 26, fig. 13.

Valve elliptical, acute. Length, 0.074 to 0.084 millimeter; breadth, 0.026 to 0.04 millimeter. Costæ 4 to 6 in 0.01 millimeter. Geographic distribution: Sea of Japan.

COCCONEIS PELTA A. Schmidt var. SINICA var. nov. Plate 2, fig. 4.

Valve broad elliptical. Length, 0.012 millimeter; breadth, 0.0065 millimeter. Striæ 12 in 0.01 millimeter. Typical *Cocconeis pelta* is known from the North Sea.

COCCONEIS GREVILLEI W. Smith var. TYPICA Cleve. Plate 1, fig. 8.

V. HEURCK, Synopsis pl. 28, figs. 10, 11.

Valve broad elliptical with rounded ends. Length, 0.33 millimeter; breadth, 0.027 millimeter. Geographic distribution: New Zealand, Galapagos and Sandwich Islands, Japan, Ceylon, West Indies, English Channel.

ACHNANTHES BREVIPES Agardh var. INTERMEDIA Kützing.

V. HEURCK, Synopsis 129, pl. 26, figs. 21–24.

Valve linear-elliptical. Length, 0.035 to 0.044 millimeter; breadth, 0.009 to 0.01 millimeter. Striæ 10 to 12 in 0.01 millimeter. Geographic distribution: Brackish and marine waters. Finmark, coasts of Britain, North, Baltic, Caspian, and Mediterranean Seas, Amsterdam Islands.

ACHNANTHES BREVIPES Agardh var. JAPONICA var. nov. Plate 2, fig. 9.

Valve elongate-linear-elliptical. Length, 0.091 millimeter; breadth, 0.014 millimeter. Striæ 10 in 0.01 millimeter. Geographic distribution: Sea of Japan.

ACHNANTHES BREVIPES Agardh var. LEUDUGERI Tempere and Brun. Plate 2, fig. 13.

TEMPERE and BRUN, Diatom. fossil. Japon. 9, pl. 9, fig. 11; = *Achnanthes kerguelensis* CASTRACANE in Voy. Challenger, 41, pl. 20, fig. 15.

Valve broadly lanceolate with obtuse ends. Length, 0.042 millimeter; breadth, 0.017 millimeter. Striæ 8 to 10 in 0.01 millimeter. Geographic distribution: North Sea, Kerguelen Land, Japan (fossil).

NAVICULA BRASILIENSIS Grunow. Plate 1, fig. 6.

A. SCHMIDT, Atlas Diatom. pl. 6, figs. 19–25, 31–33.

Valve lanceolate with slightly subrostrate ends. Length, 0.115 millimeter; breadth, 0.035 millimeter. Striæ 10 in 0.01 millimeter. Geographic distribution: Atlantic coast of North America, West Indies, Campeche Bay, Brazil, Bab el Mandeb, Zanzibar, Madagascar, Ceylon, Singapore, Labuan, China, Japan, New Caledonia, Samoa, Sandwich Islands.

NAVICULA SCOPULORUM Brébisson.

V. HEURCK, Synopsis 99, Suppl. B, fig. 28.

Valve linear with broad rounded ends. The middle part and the end of the valve are slightly gibbous. Length, 0.14 milli-

meter; breadth, 0.012 millimeter. Striæ 18 to 20 in 0.01 millimeter. Geographic distribution: Brackish water. South coasts of England, Mediterranean and Adriatic Seas, Sumatra, Labuan, Japan, East Cape, North Siberia, Brazil.

NAVICULA (SCHIZONEMA) MOLLIS W. Smith.

V. HEURCK, Synopsis pl. 15, figs. 22, 23.

Valve lanceolate, obtuse. Length, 0.03 millimeter; breadth, 0.007 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: Arctic America, Cape Sabine, Bohuslan, North and Adriatic Seas.

NAVICULA (SCHIZONEMA) RAMOSISSIMA Agardh var. SETACEUM Kützing.

V. HEURCK, Synopsis 111, pl. 15, fig. 13.

Valve narrow linear-lanceolate with subrostrate end. Length, 0.034 millimeter; breadth, 0.005 millimeter. Striæ parallel, 18 in 0.01 millimeter. Geographic distribution: North Sea.

DIPLONEIS SMITHII Brébisson.

A. SCHMIDT, Atlas Diatom. pl. 7, figs. 16, 17.

Valve elliptical. Length, 0.047 millimeter; breadth, 0.02 millimeter. Striæ 9 in 0.01 millimeter. Geographic distribution: Franz Josef Land, Spitzbergen, Sea of Kara, Finmark, Gulf of Bothnia, Baltic, North, and Mediterranean Seas, Madagascar, Seychelles, Tasmania, Java, New Zealand, Colon, Campeche Bay.

FRUSTULIA LEWISIANA Greville. Plate 2, fig. 16.

GREVILLE, T. M. S. II, p. 15, pl. 1, fig. 7.

Valve linear with parallel margins and broad rounded ends. Length, 0.102 to 0.17 millimeter; breadth, 0.017 to 0.03 millimeter. Geographic distribution: Brackish water. Sierra Leone, Cameroon, India, Batavia, Sendai, Japan (fossil), Brazil, Florida, Georgia.

FRUSTULIA INTERPOSITA Lewis var. CHINENSIS var. nov. Plate 2, fig. 15.

Valve linear with parallel margins and broad rounded ends. Length, 0.068 millimeter; breadth, 0.008 millimeter. Transverse striæ about 24, longitudinal 18 to 20 in 0.01 millimeter. Geographic distribution: The typical form is known in brackish waters of America.

TRACHYNEIS ASPERA Ehrenberg var. CHINENSIS var. nov. Plate 2, fig. 6.

Valve linear-lanceolate, obtuse, asymmetrical. Length, 0.107 millimeter; breadth, 0.03 millimeter. Axial area broad, unilateral. Central area also broad in one side with a stauros. Al-

veoli forming transverse striæ, radiate throughout, 8 in 0.01 millimeter in more or less oblique rows.

TRACHYNEIS ASPERA Ehrenberg var. PULCHELLA W. Smith. Plate 2, fig. 14.

A. SCHMIDT, Atlas Diatom. pl. 48, figs. 12, 13.

Valve elliptic with obtuse ends. Length, 0.064 millimeter; breadth, 0.03 millimeter. Striæ 8 in 0.01 millimeter. Geographic distribution: North Sea, Philippine Islands, Samoa, Sandwich Islands.

PLEUROSIGMA ELONGATUM W. Smith var. SINICA var. nov. Plate 3, fig. 2.

Valve sigmoid, elongate, gradually attenuate to the acute ends. The middle part of the valve slightly undulate. Length, 0.2 millimeter; breadth, 0.025 millimeter. Transverse and oblique striæ 20/18 in 0.01 millimeter.

PLEUROSIGMA ANGULATUM Quekett. Plate 3, fig. 9.

PERAGALLO, Monogr. Pleurosigma pl. 5, fig. 3.

Valve rhomboidal-lanceolate, slightly angular in the middle. Length, 0.195 millimeter; breadth, 0.04 millimeter. Geographic distribution: North Sea, Barbados.

PLEUROSIGMA LONGUM Cleve var. INFLATA Peragallo. Plate 3, fig. 4.

PERAGALLO, Monogr. Pleurosigma pl. 1, fig. 10.

Valve lanceolate, sigmoid with acute ends. Length, 0.03 millimeter; breadth, 0.034 millimeter. Geographic distribution: Mediterranean Sea.

GYROSIGMA DISTORTUM W. Smith. Plate 3, fig. 3.

PERAGALLO, Monogr. Pleurosigma pl. 8, fig. 32.

Valve lanceolate, slightly sigmoid. Length, 0.088 millimeter; breadth, 0.02 millimeter. Geographic distribution: Spitzbergen, North Sea, English Channel, Jonian Archipelago, Cameroon, Africa.

GYROSIGMA SPENCERII W. Smith var. ACUTIUSCULA Grunow (?). Plate 3, fig. 8.

PERAGALLO, Monogr. Pleurosigma pl. 8, fig. 32.

Valve lanceolate, slightly sigmoid. Length, 0.061 millimeter; breadth, 0.01 millimeter. Geographic distribution: Fresh water. Sweden, Finland, Belgium, Saxony, East Indies, Japan, Tasmania, New Zealand, North America.

GYROSIGMA GROVEI Cleve. Plate 3, fig. 6.

PERAGALLO, Monogr. Pleurosigma pl. 8, fig. 1.

Valve linear, sigmoid at the attenuated, obliquely rounded ends. Length, 0.034 millimeter; breadth, 0.032 millimeter. Geographic distribution: Brackish water. Java, Singapore.

GYROSIGMA SCALPROIDES Rabenhorst var. EXIMIA Thw. Plate 3, fig. 7.

PERAGALLO, Monogr. Pleurosigma pl. 8, fig. 47.

Valve linear with broad rounded ends. Length, 0.079 to 0.085 millimeter; breadth, 0.01 to 0.013 millimeter. Striæ 20/24 in 0.01 millimeter. Geographic distribution: Fresh water. Sweden, England, Belgium, Bengal.

GYROSIGMA FASCIOLA Ehrenberg var. TENUIROSTRIS Grunow. Plate 3, fig. 5.

PERAGALLO, Monogr. Pleurosigma pl. 8, fig. 42.

Valve lanceolate, slightly sigmoid with long beaks. Length, 0.105 millimeter; breadth, 0.009 millimeter. Geographic distribution: Seas of Kara and Japan.

AMPHORA ANGUSTA (Gregory) Cleve var. CHINENSIS var. nov. Plate 2, fig. 10.

Valve gibbous in the middle with capitate ends. Length, 0.04 millimeter; breadth, 0.01 millimeter. Striæ 18 in 0.01 millimeter. A form related to var. *diducta* A. Schmidt, Atlas Diatom. pl. 28, figs. 8, 13.

RHOPALODIA MUSCULUS Kützing var. CONSTRICTA W. Smith.

PERAGALLO, Diatom. Mar. France pl. 77, figs. 11–17.

Length, 0.025 to 0.042 millimeter; breadth, 0.02 millimeter. Geographic distribution: Brackish and marine waters.

NITSCHIA MAXIMA Grunow.

V. HEURCK, Synopsis pl. 65, fig. 1, 2.

Length, 0.77 millimeter; breadth, 0.025 millimeter. Costæ 4 to 5 in 0.01 millimeter. Geographic distribution: Adriatic Sea.

NITSCHIA SIGMA Kützing var. SIGMATELLA (Gregory) Grunow.

V. HEURCK, Synopsis pl. 66, figs. 6, 7.

Length, 0.0272 to 0.03 millimeter; breadth, 0.0085 millimeter. Coarse lines 7 to 8 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans.

NITSCHIA OBTUSA W. Smith.

A. SCHMIDT, Atlas Diatom. pl. 336, figs. 20–21.

Length, 0.115 millimeter; breadth, 0.006 millimeter. Fine lines 30 in 0.01 millimeter. Geographic distribution: Brackish water.

NITSCHIA OBTUSA W. Smith var. BREVISSIMA Grunow.

V. HEURCK, Synopsis, pl. 67, fig. 4.

Length, 0.059 to 0.069 millimeter; breadth, 0.005 to 0.006 millimeter. Costæ 8 in 0.01 millimeter. Geographic distribution: Brackish water.

NITSCHIA LORENZIANA Grunow var. SUBTILIS Grunow.

A. SCHMIDT, Atlas Diatom. pl. 335, figs. 6–8.

Length, 0.081 millimeter; breadth, 0.0042 millimeter. Striæ 15 in 0.01 millimeter. Geographic distribution: North and Mediterranean Seas, Ceylon.

NITSCHIA LANCETTULA O. Müller var. CHINENSIS var. nov. Plate 2, fig. 8.

Valve lanceolate with acute noncapitate ends. Length, 0.028 to 0.03 millimeter; breadth, 0.0068 to 0.0075 millimeter. Lines of puncta 12 in 0.01 millimeter. Coarse lines 5 to 6 in 0.01 millimeter. The typical form of *N. lancettula* is known from Tanganyika Lake, Africa.

NITSCHIA SOCIALIS Gregory.

PERAGALLO, Diatom. Mar. France pl. 72, fig. 8.

Length, 0.08 millimeter; breadth, 0.007 millimeter. Fine lines 18 to 20 in 0.01 millimeter. Coarse dorsal lines 7 in 0.01 millimeter. Geographic distribution: Adriatic Sea.

NITSCHIA MACILENTA Gregory forma ABBREVIATA Grunow.

PERAGALLO, Diatom. Mar. France pl. 72 fig. 2.

Length, 0.127 to 0.135 millimeter; breadth, 0.0068 to 0.008 millimeter. Geographic distribution: North and Mediterranean Seas.

NITSCHIA GRANULATA Grunow. Plate 1, fig. 10.

PERAGALLO, Diatom. Mar. France pl. 69, fig. 20.

Length, 0.048 millimeter; breadth, 0.01 millimeter. Striæ 6 in 0.01 millimeter. Geographic distribution: Atlantic and Pacific Oceans, North America, Japan, China, Ceylon.

NITSCHIA (GOMPHONITZSCHIA) CHINENSIS sp. nov. Plate 3, fig. 1.

Valve club-shaped, increasing in width from base to apex, slightly curved; its surface marked by transverse lines, the most of which are curved in the middle or furcated. A longitudinal line runs through the length of the valve and has the appearance of the coarse lines of *Nitschia.* Length, 0.5 to 0.065 millimeter; breadth, 0.0057 to 0.011 millimeter. Transverse lines 5 in 0.01 millimeter.

SURIRELLA FLUMINENSIS Grunow. Plate 1, fig. 5.

A. SCHMIDT, Atlas Diatom. pl. 4, fig. 9; pl. 5, fig. 6.

Valve ovate. Length, 0.053 millimeter; breadth, 0.035 millimeter. Geographic distribution: North, Mediterranean, and Yellow Seas, Japan.

SURIRELLA VOIGTII sp. nov. Plate 1, figs. 1 to 3; pl. 2, fig. 1.

Valve elongated ovate, one end broad and rounded, the other end elongated, somewhat pointed and curved; outer rim a narrow band, within the rim broad ribs or costæ proceed toward the center, making a band about the middle of the valve and leaving a hyaline thin central area about one-tenth the valve's diameter. Each costa begins at the outer band with a broad enlargement, covered with thin striation, but is bordered for a short distance near its middle part of the valve with a row of beards on the side. Length, 0.4 to 0.102 millimeter; breadth, 0.023 to 0.047 millimeter. Striæ 15 to 18 in 0.01 millimeter. Named in honor of Mr. Manfred Voigt, Shanghai.

ILLUSTRATIONS

PLATE 1

FIGS. 1 to 3. *Surirella voigtii* sp. nov.
FIG. 4. *Biddulphia arcticum* (Brightwell) Cleve var. *formosa* Brightwell.
5. *Surirella fluminensis* Grunow.
6. *Navicula brasiliensis* Grunow.
7. *Actinoptychus annulatus* (Wallich) Grunow var. *minor* Grunow.
8. *Cocconeis grevillei* W. Smith var. *typica* Cleve.
9. *Synedra robusta* Ralfs var. *sinica* var. nov.
10. *Nitschia granulata* Grunow.
11. *Biddulphia grundleri* A. Schmidt.

PLATE 2

FIG. 1. *Surirella voigtii* sp. nov.
FIGS. 2 and 3. *Biddulphia grundleri* A. Schmidt.
FIG. 4. *Cocconeis pelta* A. Schmidt var. *japonica* var. nov.
5. *Biddulphia concava* Mann.
6. *Trachyneis aspera* Ehrenberg var. *chinensis* var. nov.
7. *Grammatophora angulosa* Ehrenberg var. *hamulifera* Kützing.
8. *Nitschia lancettula* O. Müller var. *chinensis* var. nov.
9. *Achnanthes brevipes* Agardh var. *japonica* var. nov.
10. *Amphora angusta* (Gregory) Cleve var. *chinensis* var. nov.
FIGS. 11 and 12. *Biddulphia obtusa* Grunow.
FIG. 13. *Achnanthes brevipes* Agardh var. *leudugeri* Tempere and Brun.
14. *Trachyneis aspera* Ehrenberg var. *pulchella* W. Smith.
15. *Frustulia interposita* Lewis var. *chinensis* var. nov.
16. *Frustulia lewisiana* Greville.

PLATE 3

FIG. 1. *Nitschia* (*Gomphonitschia*) *chinensis* sp. nov.
2. *Pleurosigma elongatum* W. Smith var. *sinica* var. nov.
3. *Gyrosigma distortum* W. Smith.
4. *Pleurosigma longum* Cleve var. *inflata* Peragallo.
5. *Gyrosigma fasciola* Ehrenberg var. *tenuirostris* Grunow.
6. *Gyrosigma grovei* Cleve.
7. *Gyrosigma scalproides* Rabenhorst var. *eximia* Thw.
8. *Gyrosigma spencerii* W. Smith var. *acutiuscula* Grunow (?).
9. *Pleurosigma angulatum* Quekett.

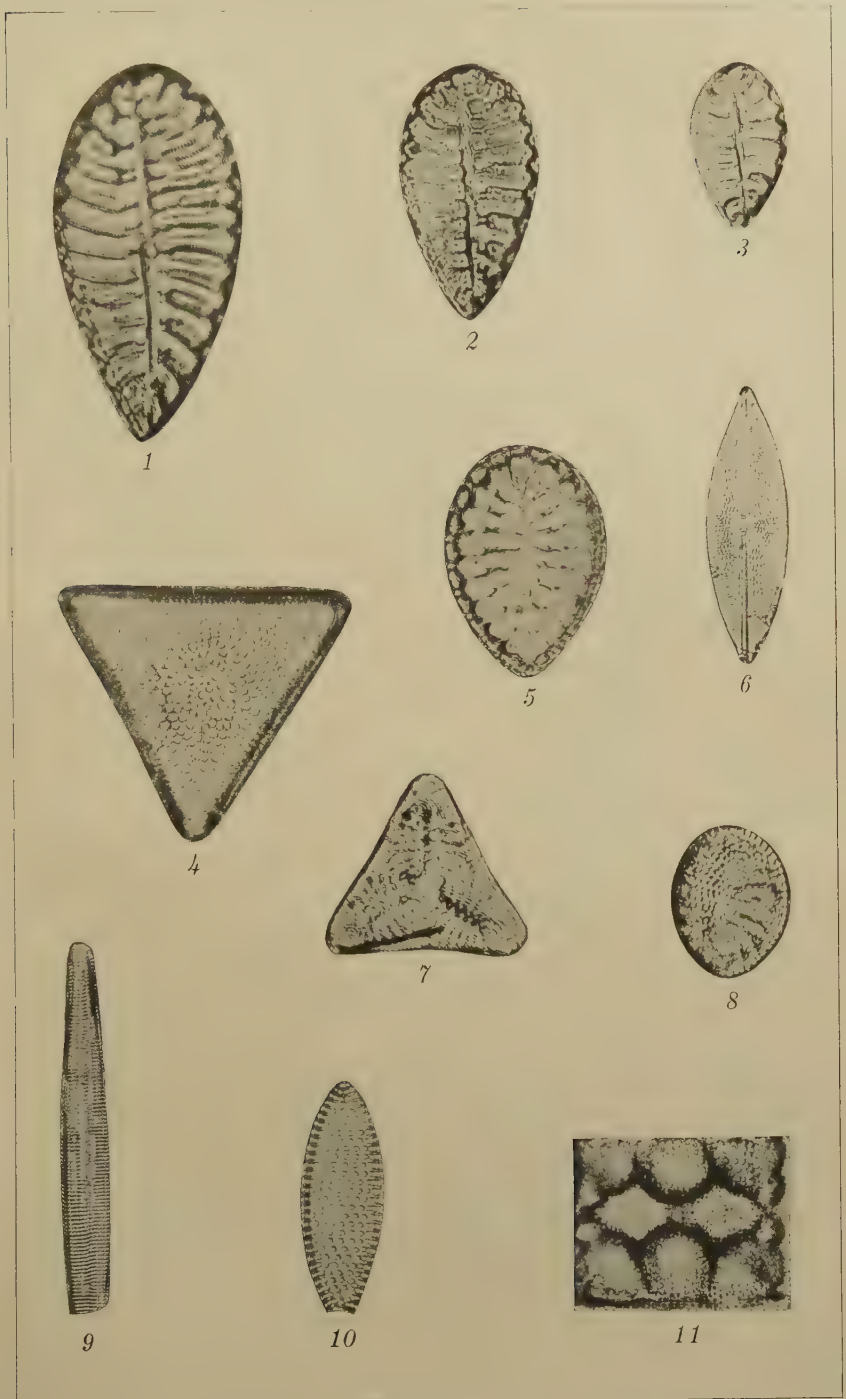


PLATE 1.

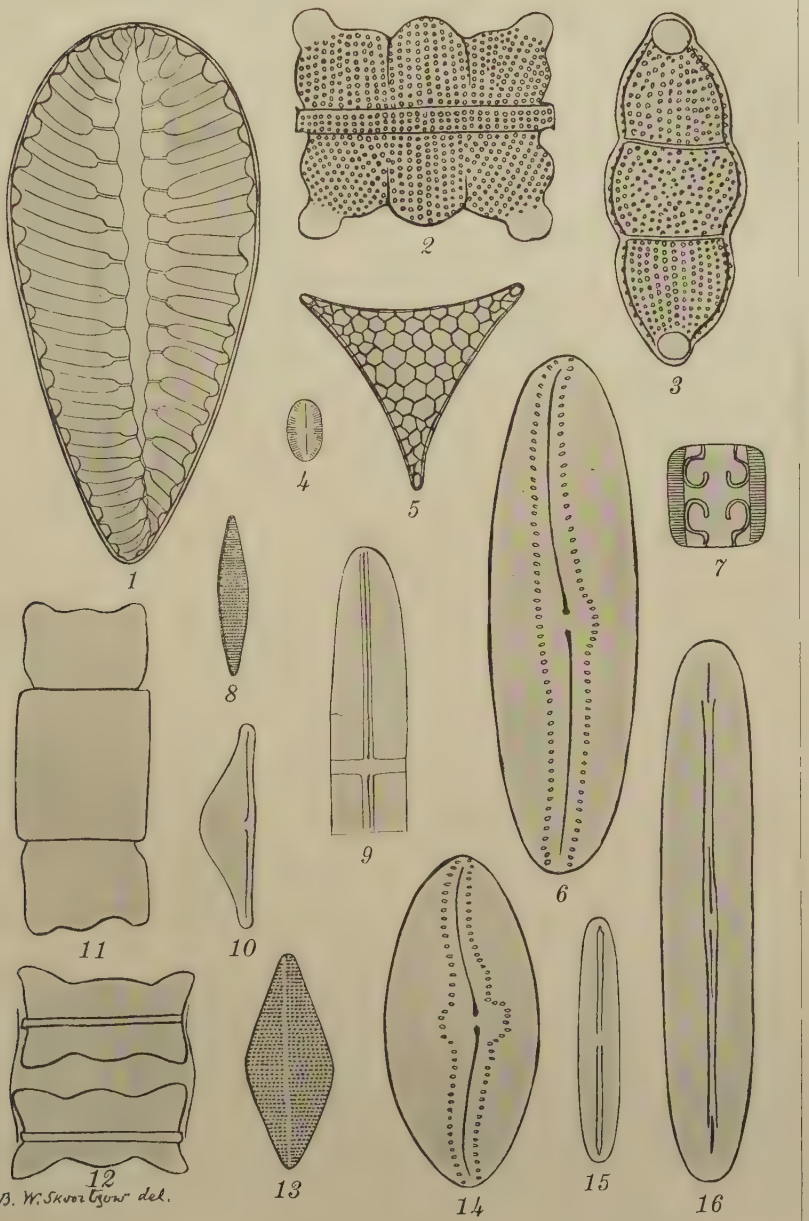


PLATE 2.

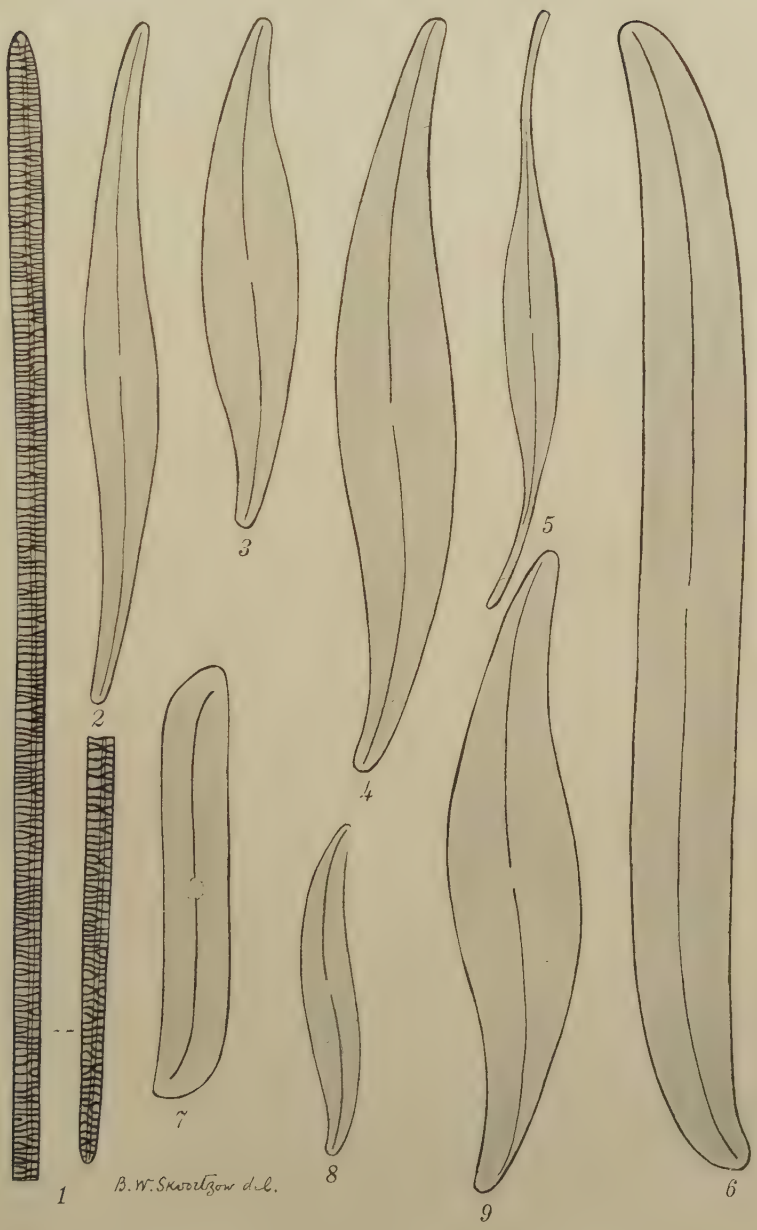


PLATE 3.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM THE PHILIPPINES (DIPTERA), XIII[1]

By Charles P. Alexander

Of Amherst, Massachusetts

THREE PLATES

The crane flies discussed at this time are all from Mount Apo, Mindanao, where they were collected by my former student, Mr. Charles F. Clagg. Keys are provided for the separation of the Philippine species of *Dolichopeza*, *Helius*, and *Pseudolimnophila*.

TIPULINÆ

SCAMBONEURA CLAGGI sp. nov. Plate 1, fig. 1; Plate 2, fig. 19.

General coloration orange, the præscutal stripes scarcely evident; antennæ (male) short; wings with Rs in alignment with the remaining elements of the cord, opposite Sc_2; male hypopygium with the outer dististyle a curved rod, the apex blackened and obliquely truncated; appendage of ninth sternite a depressed prow-shaped lobe, narrowed to the obtuse apex.

Male.—Length, about 12.5 to 13 millimeters; wing, 14.5 to 15.

Female.—Length, about 18 to 19 millimeters; wing, 15 to 16.

Frontal prolongation of head orange; palpi dark brown. Antennæ (male) relatively short, if bent backward not extending far beyond the root of the halteres; first scapal segment obscure yellow, the remainder of the organ black. Head orange, with a narrow capillary brown median line, together with less distinct brown spots on the orbits.

Mesonotal præscutum orange-yellow, with three more reddish-orange stripes that are little distinct against this background; remainder of mesonotum chiefly obscure orange or olivaceous orange, the scutal lobes a little darker than the median portion, scutellum with a more or less distinct brown median vitta. Pleura yellow. Halteres dark brown, the base of the stem very

[1] Contribution from the entomological laboratory, Massachusetts State College.

restrictedly pale. Legs with the coxæ and trochanters orange; remainder of legs black, the femoral bases restrictedly brightened. Wings (Plate 1, fig. 1) whitish hyaline, cell Sc and the stigma darker; veins black. Venation: Sc_1 present; Sc_2 ending opposite Rs, the latter in oblique alignment with the remaining elements of the cord; inner end of cell R_3 lying slightly proximad of that of cell R_5.

Abdominal tergites obscure yellow, ringed at midlength with broad violaceous annuli, the pale basal ring wider than the concolorous apex of the segment; subterminal segments and hypopygium passing into black; sternites more uniformly yellow. In the female, the apical dark ring of the sternite is more broadly metallic blue, the pale apex being obliterated or nearly so. Male hypopygium (Plate 2, fig. 19) with the lateral lobes of the tergite, 9*t*, broadly obtuse, each at apex on lower face with a blackened spine, the remainder of lobe with smaller microscopic black spinules; no median projection. Outer dististyle, *od*, a conspicuous curved rod, somewhat as in *mindanaoensis*, the apex obliquely truncated and blackened. Inner dististyle, *id*, a broadly flattened blade, the terminal beak unusually small. Appendage of ninth sternite, 9*s*, relatively slender, prow-shaped, broadest just before midlength, gradually narrowed to the slender tip, the surface densely clothed with microscopic setulæ. Gonapophyses, *g*, appearing as yellow blades, bifid at tip, the lateral portions produced into a slender black spine; face of blade with a second, much smaller spine.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male, Seliban River, altitude 7,000 feet, September 3, 1930; allotype, female, Mainit River, altitude 6,500 feet, September 10, 1930; paratopotype, male, with holotype; paratypes, 2 males, 1 female, with allotype, altitude 6,000 feet, September 9, 1930; 1 male, Galog River trail, altitude 5,000 to 6,000 feet, September 12, 1930.

This very distinct *Scamboneura* is named in honor of the collector of this rich series of Tipulidæ from Mindanao, Mr. Charles F. Clagg. By my latest key to the Philippine species of *Scamboneura*[2] the present species runs to couplet 3 which includes *S. primæva* Alexander and *S. primogenia* Alexander, both of Luzon. The fly is more closely allied to the more recently defined *S. mindanaoensis* Alexander (Mindanao), differing conspicuously in the hypopygial structure. These two species are

[2] Philip. Journ. Sci. 45 (1931) 266.

very distinct from all other described species of the genus in the peculiar structure of the outer dististyle of the male hypopygium.

SCAMBONEURA CITRIDORSUM sp. nov. Plate 1, fig. 2; Plate 2, fig. 20.

General coloration orange, the præscutal stripes almost concolorous; antennæ (male) long, the flagellum black; vertex orange, with a narrow brown line; wings with the elements of the anterior cord in subtransverse alignment, the inner end of cell R_3 lying slightly more distad than cell R_5; male hypopygium with the appendage of the ninth sternite a depressed spatula, the apex not at all emarginate or bilobed.

Male.—Length, about 12.5 millimeters; wing, 13.5.

Frontal prolongation of head orange, the nasus darker, tufted with dark setæ; palpi obscure yellow, the outer segments darker. Antennæ (male) elongate, if bent backward extending about to midlength of the second abdominal segment; scapal segments brownish yellow, flagellum black; flagellar segments elongate-cylindrical, the basal enlargement small. Head orange, with a narrow brown line that extends cephalad almost to the summit of vertex.

Thoracic notum almost clear orange, the præscutal stripes ill-defined to nearly obsolete; scutellum more infuscated. Pleura yellowish orange, immaculate. Halteres light brown, the knobs dark brown. Legs with the coxæ and trochanters yellow; femora obscure yellow, passing into brownish black at tips; tibiæ and tarsi black. Wings (Plate 1, fig. 2) subhyaline, cell Sc and the stigma darker brown; a narrow to scarcely evident dusky marginal clouding from wing apex to opposite cell Cu; veins and macrotrichia black. Venation: Elements of anterior cord in subtransverse alignment, the inner end of cell R_3 lying slightly more distad than cell R_5; m-cu transverse to the wing, in alignment with the remaining elements of the cord.

Abdominal tergites orange, marked medially and less evidently on margins with brownish black, the amount of the former increasing conspicuously on the outer segments to form a complete but irregularly outlined median stripe; subterminal segments and hypopygium uniformly darkened. Male hypopygium (Plate 2, fig. 20) with the median tooth of the tergite, 9*t*, small and inconspicuous. Inner dististyle, *id*, long and narrow, gradually narrowed into a long apical darkened point, the extreme tip obtusely rounded. Appendage of ninth sternite, 9*s*, a depressed spatula, widened outwardly, the apex subtruncate, not

emarginate or bilobed; entire surface densely set with setæ and setulæ, the latter arranged in definite groups of three or four; marginal setæ longer, especially on the lateral and subapical portions.

MINDANAO, Davao district, Mount Apo, Seliban River, altitude 7,000 feet, September 3, 1930 (*C. F. Clagg*); holotype, male.

By my key to the Philippine species of *Scamboneura*[3] the present species runs to *S. subtransversa* Alexander, with which it agrees in the nature of the anterior cord of the wings, differing conspicuously therefrom in the coloration and in the structure of the male hypopygium.

SCAMBONEURA SUBDOTATA sp. nov. Plate 2, fig. 21.

General coloration yellow, the præscutum with three metallic green stripes that are narrowly bordered by black; antennæ (male) elongate, the basal flagellar segments bicolorous; head with a conspicuous occipital area and a median black line to summit of vertex; wings with anterior cord bowed; male hypopygium with the ninth tergite transverse, the lateral shoulders rounded; appendage of ninth sternite produced into conspicuous lateral horns.

Male.—Length, about 12 millimeters; wing, 11.5; antenna, about 6.

Female.—Length, about 18 millimeters; wing, 14.

Frontal prolongation of head yellow, nasus black; palpi yellow, the elongate terminal segment passing into brown. Antennæ (male) elongate, as shown by the measurements; scape yellow; flagellum black, the apex of each of the basal three segments yellow, most extensively so on the first segment, the amount decreasing outwardly. Head orange, the occipital area extensive, gray, margined with black, the latter coloration continued cephalad onto the summit of the vertical tubercle; posterior orbits narrowly grayish.

Pronotum brownish gray laterally, brownish medially in front, yellow medially behind. Mesonotal præscutum yellow, with three shiny dark green stripes that are narrowly bordered by black; a dusky lateral extension from the cephalic portion of the lateral stripes; humeral region and lateral margin of sclerite before the suture brownish gray; suture darkened medially; scutum obscure yellow, the lobes chiefly covered by two confluent dark green areas, the mesal edge of which is blackened; scutellum and postnotum brownish testaceous, vaguely darker medial-

[3] Loc. cit.

ly. Pleura obscure yellow, the dark pattern of *dotata* but little evident, appearing as very pale brown areas on the propleura, anepisternum, and ventral sternopleurite. Halteres black, the extreme base of stem brightened. Legs with the coxæ yellow, the fore coxæ darkened on cephalic face; trochanters yellow; femora obscure yellow, darkened beyond base; tibiæ and tarsi passing from brown to dark brown. Wings proportionately wider than in *dotata;* venation almost the same, with m-cu more erect and vein 2d A a little longer.

Abdominal tergites obscure yellow, each with a median black area on the posterior ring; hypopygium chiefly yellow and brownish yellow. Male hypopygium (Plate 2, fig. 21) with the ninth tergite, 9*t*, transverse, the lateral shoulders evenly rounded, the median region with blackened spicules, as shown. Dististyles about as illustrated, the inner, *id*, relatively narrow, blackened. Appendage of ninth sternite, 9*s*, produced laterad into conspicuous lobes that are tufted with setæ, the apex beyond these lobes obtusely rounded and margined with pale, toothlike setæ.

MINDANAO, Davao district, Mount Apo, Galog River, altitude 6,000 feet, September 16, 1930 (*C. F. Clagg*) ; holotype, male.

By my key to the Philippine species of *Scamboneura*[4] the present fly runs to *S. dotata* Osten Sacken, which appears to be its nearest ally. *Scamboneura subdotata* is told by the longer antennæ and the very different details of the male hypopygium, notably of the tergite and appendage of the ninth sternite.

SCAMBONEURA OPACINOTUM sp. nov. Plate 2, fig. 22.

General coloration yellowish and gray, the mesonotal præscutum with three brown stripes that are more or less confluent and covered by a gray pruinosity; basal flagellar segments black, with narrow yellow apices; pleura whitish yellow, unmarked; wings whitish subhyaline, the stigma darker; anterior cord strongly bowed; male hypopygium having the tergite with abundant microscopic blackened points; apical beak of inner dististyle stout; appendage of ninth sternite a depressed lobe that is folded into a half-cylinder by the upcurving of the margins.

Male.—Length, about 12 to 13 millimeters; wing, 11.5 to 12.

Female.—Length, 15 to 16 millimeters; wing, 12 to 12.5.

Frontal prolongation of head obscure yellow, the nasus darkened; palpi obscure yellow, the outer segments darkened. Antennæ (male) relatively elongate, if bent backward extending

[4] Loc. cit.

about opposite or slightly beyond midlength of the second abdominal segment; first scapal segment brown, the second clear light yellow; flagellar segments black, the apices of the basal two restrictedly pale yellow. Posterior portion of vertex and the occiput gray pruinose, the remainder of vertex and front yellow, the occipital portions with a light silvery pruinosity; central portion of vertex with a narrow velvety-black median vitta that almost attains the summit of the tubercle.

Mesonotal præscutum with the ground color obscure yellow, with three brown stripes that may become entirely confluent and so cover the disk; entire surface heavily pruinose; scutal lobes gray, the restricted median region obscure yellow; scutellum brownish yellow; postnotal mediotergite gray medially, obscure yellow laterally. Pleura obscure yellow, whitish pruinose, not or scarcely variegated with darker. Halteres obscure yellow, the stem more obscure, the knobs brownish black. Legs with the coxæ pale, whitish pruinose; trochanters yellow; femora obscure yellow, with dark setæ that somewhat obscure the ground color, especially distally; remainder of legs passing through yellowish brown to black. Wings whitish subhyaline, cell Sc more yellowish; stigma pale brown; veins black, with long conspicuous macrotrichia. Venation: Anterior cord very deeply bowed, as usual in the more-specialized species of the genus.

Abdominal segments yellow, the tergites trivittate with dark brown, the proximal segments narrowly ringed with yellow; hypopygium brownish black. Male hypopygium (Plate 2, fig. 22) with the tergite, 9*t*, provided with abundant blackened spinous points, the larger ones on the ventral face of the lobes; median tonguelike point small. Inner dististyle, *id*, with the apical point stouter than in *banahaoensis*. Appendage of the ninth sternite, 9*s*, of a form difficult of description and illustration, being a depressed structure having the margins upcurved to form a half-cylinder, the lateral ears projecting.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male; allotype, female, Mainit River, altitude 6,500 feet, September 14, 1930; paratopotypes, 5 males and females, September 10 to 14, 1930; paratypes, 3 males, Galog River, altitude 6,000 feet, September 7 and 8, 1930; 1 male, Seliban River, altitude 6,500 feet, September 11, 1930; Bakraeyon, altitude 8,000 feet, September 16, 1930.

By my key to the Philippine species of *Scamboneura*[5] the present species runs to *S. banahaoensis* Alexander (Luzon) which differs in the details of the hypopygium, especially the number and arrangement of the spinulæ on the tergite, the stouter beak of the inner dististyle, and the conformation of the appendage of the ninth sternite.

Genus DOLICHOPEZA Curtis

The genus *Dolichopeza* is very greatly developed in the Philippine fauna, the majority of the species falling within the limits of the subgenus *Nesopeza* Alexander, as restricted by the present writer. A single species of *Mitopeza* Edwards has been described from Luzon. The three species referred provisionally to *Dolichopeza*, s. s., deserve special comment. In several respects these species are closer to *Tipula* than to *Dolichopeza*, and almost certainly form a close connection between these two groups. The following attempt to key the Philippine species of the genus is based especially on the structure of the male hypopygium.

Key to the Philippine species of Dolichopeza Curtis.

1. Wings with cell 1st M_2 closed. (*Mitopeza* Edwards.) (Luzon.) *D.* (*M.*) *rizalensis* Alexander.
   Wings with cell 1st M_2 open by atrophy of the basal section of M_3 ..... 2.
2. Rs short to transverse, not exceeding two-thirds the length of the long m-cu; tibiæ and tarsi entirely black. (*Dolichopeza* Curtis, s. s.; *malagasya* group.) ..... 3.
   Rs elongate, longitudinal in position, two or more times the length of m-cu; tarsi, and usually the tibiæ also, more or less whitened. (*Nesopeza* Alexander.) ..... 5.
3. General coloration of head and thorax orange, the thoracic pleura immaculate; wings conspicuously patterned with darker in the outer radial field, especially a cloud beyond the anterior cord that sends seams outward along the radial veins; antennal flagellum black. (Mindanao.) ..... *D.* (*D.*) *ata* sp. nov.
   General coloration of head and thorax more yellowish testaceous, the pleura with small black spots on the pteropleurite; wings only inconspicuously patterned; antennæ with the flagellum brown or weakly bicolorous ..... 4.
4. Antennæ (male) relatively elongate, if bent backward extending to beyond the base of abdomen; knobs of halteres blackened. (Luzon.) *D.* (*D.*) *isolata* Alexander.

[5] Loc. cit.

Antennæ (male) short, if bent backward extending to about mid-distance between the roots of the wings and the halteres; knobs of halteres with the outer half abruptly yellow. (Mindanao.)

D. (*D.*) *bilan* sp. nov.

5. Rs elongate, angulated and long-spurred at origin, exceeding vein R_{2+3} in length; wings with a heavy dark brown costal pattern or conspicuously spotted with dark ..... 6.

Rs relatively short, not angulated or spurred at origin and not exceeding vein R_{2+3} in length; wings unmarked, except for the stigmal area ..... 13.

6. Forks of medial field of wing shallow; that is, cell M_1 less than twice as long as its petiole. (*costalis* group.) ..... 7.

Forks of medial field of wing deep; that is, cell M_1 about three or more times as long as its petiole. (*gracilis* group.) ..... 8.

7. Wings with a dark costal pattern only. (Luzon.)

D. (*N.*) *oberon* Alexander.

Wings with the costa more or less darkened, the disk and posterior wing margin with conspicuous yellowish brown areas that are narrowly margined with darker. (Mindanao.)

D. (*N.*) *multiguttula* sp. nov.

8. Wings dusky, the costa dark brown, cell R_2 not variegated by pale spots; legs with femora and tibiæ darkened, the latter with a narrow white ring before the black tips. (Mindanao.)

D. (*N.*) *nigrofemorata* sp. nov.

Wings with the dark costal border variegated by pale marginal spots in the outer ends of cells R_2 and R_3; legs with the femora and tibiæ pale, yellowish or yellowish white, the tips narrowly darkened ..... 9.

9. Thoracic pleura entirely pale or with a restricted dark pattern; all coxæ pale ..... 10.

Thoracic pleura pale, heavily variegated by dark brown, this pattern including the fore coxæ ..... 11.

10. Thoracic pleura uniformly pale; male hypopygium with the region of the basistyle produced into a powerful fascicle of setæ and spines to resemble a single powerful spine. (Mindanao.)

D. (*N.*) *spinisternata* Alexander.

Thoracic pleura pale, with an interrupted dorsal brown stripe; male hypopygium with the armature of the basistyle and sternite consisting only of long scattered setæ. (Mindanao.)

D. (*N.*) *setisternata* sp. nov.

11. Male hypopygium with the region of the basistyle produced into a slender fingerlike lobe that is tipped with spinous setæ. (Mindanao.)

D. (*N.*) *productula* sp. nov.

Male hypopygium without such production of the region of the basistyle ..... 12.

12. Thoracic pleura continuously darkened; except for the pleurotergite and dorsal membrane; male hypopygium with the sternal region unarmed except for a crown of about six flattened spinous setæ on either side of a membranous median notch. (Mindanao.)

D. (*N.*) *parvella* sp. nov.

Thoracic pleura dark, interrupted by pale areas, especially on the dorsal sternopleurite; male hypopygium with conspicuous lateral and median spines on the sternal region. (Mindanao.)
D. (*N.*) *paucispinosa* Alexander.

13. Wings cuneiformly narrowed at base; cell 2d A of wings very long and narrow, reduced to a linear strip; tarsi white, on some of the legs with central portion of basitarsi extensively blackened. (*cuneata* group.) ..... 14.
Wings not so cuneiformly narrowed, cell 2d A of wings of normal width; tarsi white, the central portion of basitarsi not blackened. (*tarsalis* group.) (Luzon.) ..... *D.* (*N.*) *haightensis* Alexander.

14. Male hypopygium with the ninth tergite very long and narrow, conspicuously arched dorsad. (*cinctitarsis* subgroup.) ..... 15.
Male hypopygium with the ninth tergite small and not greatly arched dorsad. (*cuneata* subgroup.) ..... 17.

15. Male hypopygium with the ninth tergite having the lobes broad, each obliquely truncated to weakly notched at tips, the mesal edge of each beyond midlength with a slender appendage directed cephalad and ventrad. (Luzon.) ..... *D.* (*N.*) *cinctitarsis* Alexander.
Male hypopygium with the lobes of the ninth tergite long and narrow ..... 16.

16. Male hypopygium with the apex of each lobe of the ninth tergite simple or nearly so. (Luzon.) ..... *D.* (*N.*) *annulitarsis* Alexander.
Male hypopygium with the apex of each lobe of the ninth tergite profoundly split into two slender arms. (Mindanao.)
D. (*N.*) *quadrifila* sp. nov.

17. Male hypopygium with the ninth sternite conspicuously blackened; lateral lobes of tergite broad, entire or nearly so. (Luzon.)
D. (*N.*) *melanosterna* Alexander.
Male hypopygium with the ninth sternite pale; lateral lobes of tergite divided into lateral and sublateral portions by a notch ..... 18.

18. Male hypopygium with the sublateral tooth of the tergite acute, separated from the extreme lateral lobe by a narrow V-shaped notch. (Luzon.) ..... *D.* (*N.*) *angustaxillaris* Alexander.
Male hypopygium with the sublateral tooth of the tergite relatively small, separated from the extreme lateral lobe by a very broad and shallow notch. (Mindanao.) ..... *D.* (*N.*) *bagobo* sp. nov.

DOLICHOPEZA (DOLICHOPEZA) ATA sp. nov. Plate 1, fig. 3; Plate 2, fig. 23.

Belongs to the *malagasya* group; antennæ (male) relatively elongate, the flagellum black; general coloration of head and thoracic notum orange, the præscutum with the interspaces a little darkened; thoracic pleura yellow, immaculate; knobs of halteres blackened; wings cream-colored, conspicuously variegated with brown; male hypopygium with the tergite bearing a highly compressed spatulate blade that is densely clothed with long erect setæ; inner dististyle bearing a long, tail-like extension.

Male.—Length, about 10 to 11 millimeters; wing, 13 to 13.5. Frontal prolongation of head fulvous; palpi black. Antennæ with the scapal segments yellow, the flagellum black; flagellar segments elongate-cylindrical, the basal enlargements only slightly developed, the verticils shorter than the segments. Head orange.

Mesonotal præscutum orange, the interspaces vaguely to insensibly more brownish orange; scutal lobes obscure yellow, variegated with large brown areas; scutellum brownish testaceous; postnotum yellow. Pleura yellow. Halteres with the stem brown, the knobs blackened. Legs with the coxæ and trochanters yellow; femora obscure yellow at base, passing through brown to black; tibiæ and tarsi black. Wings (Plate 1, fig. 3) cream-colored, conspicuously variegated by dark brown; stigma dark brown; cell Sc dark brown; cell C more or less infuscated, especially on distal half; extensive dusky clouds at anterior cord and as seams along the veins distad of the same; Cu and m-cu broadly and conspicuously seamed with brown; vein 2d A narrowly margined with dusky; veins brown, except in obliterative areas. Caudal half of stigma with several conspicuous macrotrichia. Venation: Forks of media very deep; base of R_2 and R_1 forming an acute angle at their point of union; R_{1+2} represented by a distinct spur that is more than one-half the length of R_2 alone.

Abdominal tergites obscure yellow, margined basolaterally and caudally with black, on segments five to nine more extensively and uniformly blackened; sternites chiefly yellow, narrowly margined caudally with brownish black; eighth sternite uniformly blackened. Male hypopygium (Plate 2, fig. 23) with the median region of the tergite, 9*t*, produced caudad into a very compressed spatulate blade, the two faces of which bear unusually long and abundant erect setæ. Outer dististyle a flattened to subcylindrical fleshy lobe. Inner dististyle, *id*, as illustrated, the posterior end prolonged into a long straight spine, the distal third blackened and glabrous.

MINDANAO, Davao district, Mount Apo, Kidapawan trail from Lake Lino, altitude 7,000 to 8,000 feet, September 20, 1930 (*C. F. Clagg*); holotype, male; paratype, male.

The specific name is that of a native tribe of the vicinity of Mount Apo. As indicated before, the species of the *malagasya* group are referred to *Dolichopeza* with much hesitation. When their limits are better understood, it seems probable that

this particular group of flies will be transferred to *Tipula,* but there can be little question that flies of this type were very similar to the ancestors of *Dolichopeza.*

DOLICHOPEZA (DOLICHOPEZA) BILAN sp. nov.

Belongs to the *malagasya* group; general coloration obscure yellow; antennæ (male) relatively short, if bent backward extending about to mid-distance between the bases of the wings and halteres; mesonotal præscutum with three obscure yellow stripes; pleura with small black spots; halteres dark, the apices of the knobs conspicuously light yellow; wings without a clearly defined dark pattern, as is the case in *D. atá.*

Male.—Length, about 10 millimeters; wing, 11.5.

Female.—Length, about 11 millimeters; wing, 11.

Frontal prolongation of head light brown to brownish yellow; palpi black. Antennæ of male of moderate length only, if bent backward extending to about mid-distance between the wings and halteres; scapal segments obscure yellow; flagellum brownish black. Head with the anterior vertex obscure yellow, the posterior vertex more infuscated, paler medially.

Mesonotal præscutum with three obscure yellow stripes, the interspaces and humeral region dark brown; median stripe vaguely divided by a faint line; scutal lobes conspicuously patterned with dark brown; scutellum and postnotal mediotergite dark, the latter slightly pruinose. Pleura obscure yellow, with small black areas on the ventral dorsopleural membrane, and with two isolated areas on the cephalic margin of the pteropleurite. Halteres infuscated, the base of stem and apex of each knob light yellow. Legs with the coxæ and trochanters yellowish testaceous; femora passing through brown to black; tibiæ and tarsi black. Wings with a dusky tinge, variegated by restricted seams along certain of the veins; cream-colored obliterative areas before and beyond the stigma, and across the basal section of M_{1+2}; veins dark, pale in the obliterative areas. A few macrotrichia in caudal half of the stigma. Venation: Forks of medial field deep.

Abdominal tergites bicolorous, the incisures broadly darkened, including the broad caudal margin and more narrow basal portion of the segment; sternites more uniformly pale, the darkened areas narrower and restricted to the caudal margins of the segments. Male hypopygium almost as in *D. atá,* differing chiefly in details of structure of the inner dististyle, there being a

conspicuous tubercle at base of the posterior spine, the latter stouter and destitute of setæ for a longer distance back from apex.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, Mainit River, altitude 6,000 feet, September 4, 1930; allotype, female, Galog River, altitude 6,000 feet, September 11, 1930, at camp fire.

The specific name is that of a native aboriginal tribe.

DOLICHOPEZA (NESOPEZA) MULTIGUTTULA sp. nov. Plate 1, fig. 4.

Belongs to the *costalis* group; general coloration of thorax pale yellow, the præscutum with three pale brown stripes, the pleura variegated with brown; legs chiefly pale, the tips of the femora and tibiæ blackened; wings subhyaline, with a heavy yellowish brown pattern, the areas bordered by darker brown; caudal margin of wing with dark areas at ends of all the veins; forks of medial field shallow.

Male.—Length, about 8 millimeters; wing, 9.

Female.—Length, about 10 millimeters; wing, 10 to 10.5.

Frontal prolongation of head very short, dark brown; palpi brownish black. Antennæ (male) relatively long and slender; second scapal segment and basal half of first flagellar segment yellow, the basal segment of scape and remainder of flagellum brown; flagellar segments elongate-cylindrical, clothed with an abundant erect pubescence and with a single verticil before apex, together with a subbasal one on the more proximal segments. Head brownish gray; anterior vertex relatively narrow, less than twice the diameter of the first scapal segment.

Mesonotal præscutum pale yellow, with three poorly defined pale brown stripes, the median one further divided by a capillary shiny line; scutal lobes with two yellowish brown areas that almost cover the lobes; scutellum and central portion of the postnotal mediotergite dark brown, the lateral margins of the latter yellow. Pleura yellow, conspicuously variegated with brown, the latter including the anepisternum, ventral sternopleurite, and meron; the dorsocaudal portion of the pleurotergite is pale brown but still darker than the ground. Halteres pale yellow, the knobs infuscated. Legs with the fore coxæ infuscated, the remaining coxæ and all trochanters yellow; femora obscure yellow, the tips narrowly blackened; tibiæ white, clearest at extreme base and again on distal third, the tip very narrowly but conspicuously blackened; tarsi snowy white. Wings (Plate 1, fig. 4) subhyaline, with a heavy pale yellowish brown pattern that is

narrowly margined with paler; costal region pale or infuscated, in the latter case variegated by pale areas; the chief darkened areas are caudal extensions of the costal field, as in the *costalis* group, but in addition, there are conspicuous marginal areas at ends of all the veins, with a larger area in outer end of cell 1st A, remote from the veins; other dark areas occur at and beyond the arculus, at m-cu, and near outer ends of the radial cells; veins brown, the anal veins paler. Macrotrichia of veins relatively long and conspicuous. Venation: Rs angulated and conspicuously spurred at origin; free tip of Sc_2 pale but preserved; R_{1+2} entirely atrophied, the juncture of R_2 with R_1 usually feebly angulated; R_3 long, upcurved at margin; forks of medial field short, cell M_1 subequal to its petiole; cell 2d A wide.

Abdominal tergites dark brown, margined laterally with yellow; in the female, the segments more variegated.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male, Mainit River, altitude 7,000 feet, September 15, 1930; allotype, female, Lino Lake to summit, 8,000 to 9,300 feet, September 18, 1930; paratype, female, Seliban River, 7,000 feet, September 3, 1930.

The wing pattern serves to separate this conspicuous fly from related regional forms.

DOLICHOPEZA (NESOPEZA) NIGROFEMORATA sp. nov. Plate 2, fig. 24.

Belongs to the *gracilis* group; general coloration obscure yellow, the mesonotal præscutum with three extensive brown stripes; femora and tibiæ dark, obscure brownish yellow to blackish, the tibiæ narrowly whitened before the extreme blackened tips; tarsi snowy white; wings dusky, with the usual dark costal pattern, cell R_2 not variegated by pale spots; male hypopygium with the region of the basistyle produced into broad shoulders that bear several powerful setæ which are directed mesad.

Male.—Length, about 10 millimeters; wing, 10 to 10.2.

Frontal prolongation of head brownish black; palpi black. Antennæ with the scape and first flagellar segment obscure yellow, the remainder of flagellum passing into black; flagellar segments cylindrical, the segments beyond the first with erect pubescence but without further differentiated verticils; terminal segment small, less than one-fifth the penultimate. Head brown, sparsely pruinose, more conspicuously so on the posterior orbits.

Mesonotal præscutum obscure yellow, with three extensive brown stripes, the median stripe expanded in front; in cases, the median stripe much paler, being best represented by a

capillary dark brown median vitta; scutal lobes obscure yellow, variegated on margins by brown; scutellum brown, the parascutella paler; postnotal mediotergite obscure testaceous yellow, darker medially. Pleura obscure brownish yellow, the pteropleurite, meron, and dorsopleural membrane clearer yellow. Halteres with the stem obscure yellow, the knobs infuscated. Legs with the coxæ and trochanters yellow; femora obscure brownish yellow to black, in the former case, the tips blackened; tibiæ dark testaceous brown, before the narrowly blackened tips brightening to white; tarsi snowy white.

Wings with a dusky suffusion, the costal border darker brown, as in the group; posterior extensions of this border across the postarcular cells, origin of Rs and along cord; cell R_2 almost uniformly dusky, not variegated with pale spots, as is usual in the group; veins dark brown. Venation: R_3 of moderate length only, about one-fifth longer than R_{2+3}; forks of medial field deep, that of cell M_1 exceeding three times the petiole.

Abdomen with the tergites black, the segments margined laterally at base and marked less distinctly medially with obscure yellow. Male hypopygium (Plate 2, fig. 24) with the median region of tergite, 9*t*, slightly produced. Outer dististyle dusky, with long conspicuous setæ. Region of sternite, 9*s*, and basistyle with the latter produced mesad and caudad into broad shoulders that bear from ten to twelve powerful setæ which are directed toward one another across the midline; sternal region with a shallow U-shaped notch, on either side of which is a low obtuse lobe set with spinous setæ, the more mesal ones smaller, the more lateral setæ long and conspicuous, very dense.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male, Lino Lake, altitude 8,000 feet, September 19, 1930; paratypes, 2 males, 1 teneral, Kidapawan trail from Lino Lake, 7,000 to 8,000 feet, September 20, 1930.

The diagnostic characters of the present species are well shown by the arrangement in the key.

DOLICHOPEZA (NESOPEZA) PRODUCTULA sp. nov. Plate 1, fig. 5; Plate 2, fig. 25.

Belongs to the *gracilis* group; general coloration buffy, the mesonotal præscutum with four brown stripes, the intermediate pair more or less confluent in front; pleura pale, variegated with dark brown, this color including the fore coxæ, ventral sternopleurite, and meron; legs pale, the tips of femora and tibiæ narrowly blackened; male hypopygium with the region of the

basistyle produced into cylindrical lobes that are tipped with spinous setæ.

Male.—Length, about 7 to 7.5 millimeters; wing, 7.5 to 8.5.

Female.—Length, about 8.5 to 9.5 millimeters; wing, 8.5 to 9.

Frontal prolongation of head short, dark brown; palpi black. Antennæ with the basal segment dusky, the second segment of scape and first segment of flagellum more yellowish; outer segments of flagellum passing into brown; flagellar segments elongate-cylindrical, provided with delicate erect setulæ and a single verticil on outer face near end of segment, this verticil not exceeding one-third the length of the segment. Head brown.

Mesonotal præscutum buffy, with four brown stripes, the intermediate pair confluent in front; scutal lobes marked on cephalic and mesal margins with a continuous brown line; scutellum brownish yellow; postnotal mediotergite a little darker. Pleura whitish, variegated with dark brown, including dorsal areas on the anepisternum and dorsal pleurotergite, and a ventral stripe including the fore coxæ, ventral sternopleurite, and meron. Halteres pale yellow, the knobs dark brown. Legs with the fore coxæ dark brown, the remaining coxæ and all trochanters yellow; femora obscure yellow, the tips brownish black; tibiæ white, the tips very narrowly darkened; tarsi white. Wings (Plate 1, fig. 5) with a pattern that is almost identical with that of *gracilis* and allies, including a dark costa that sends spurs caudad across the origin of Rs and along the anterior cord; pale areas in outer ends of cells R_2 and R_3; posterior cord and a marginal seam in the cubital and posterior medial fields restrictedly darkened; prearcular region dark. Venation: Forks of medial field deep, as in the *gracilis* group.

Abdominal tergites brownish black, variegated laterally and medially just before caudal margins of segments two to four with pale areas; subterminal segments more extensively darkened, the pale areas correspondingly restricted; sternites more extensively bicolorous, the posterior rings chiefly yellow, the incisures and basal rings infuscated. Male hypopygium (Plate 2, fig. 25) with the lateral arms of the tergite, 9*t*, conspicuously produced, directed caudad and slightly mesad, the tips very obtuse, the arms with from 15 to 20 punctures; median area of tergite raised into a low lobe. Outer dististyle a short, flattened to cylindrical lobe, provided with many setæ. Inner dististyle, *id*, about as illustrated. Basistyle produced caudad into cylindrical arms

that bear several powerful spinous setæ at and near their tips; median region of sternite, 9*s*, with a group of about three similar setæ on either side, as illustrated.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male; allotype, female, Mainit River, altitude 6,500 feet, September 10, 1930; paratypes, 1 male, type locality, altitude 6,000 feet, September 16 to 24, 1930; 1 male, 1 female, Tio Ridge, altitude 6,500 feet, September 15, 1930; 2 males, 2 females, Seliban River, altitude 6,500 feet, September 11, 1930; 1 male, 1 female, Bakraeyon, altitude 8,000 feet, September 16, 1930.

DOLICHOPEZA (NESOPEZA) PARVELLA sp. nov. Plate 2, fig. 26.

Belongs to the *gracilis* group; size small (wing, male, less than 7.5 millimeters); thoracic pleura chiefly dark brown, variegated with pale on the dorsal membrane and on pteropleurite, the anepisternum and sternopleurite continuously darkened; wings with a dark costal pattern only; male hypopygium with the sternal region produced into a low tubercle on either side of the membranous median area, these lobes crowned with about six flattened spinous setæ.

Male.—Length, about 7 millimeters; wing, 7.2.

Frontal prolongation of head brownish black; palpi dark brown. Antennæ (male) elongate, if bent backward extending to the second abdominal segment; basal segment dark brown, the remainder pale brownish testaceous; flagellar segments elongate-cylindrical, the verticils inconspicuous. Head brownish black; anterior vertex narrow; eyes large.

Mesonotal præscutum with the ground color brownish black, with three ill-defined reddish brown stripes, the median one becoming narrowed and subobsolete behind; scutal lobes dark brown, paler laterally; scutellum and postnotum dark brown. Pleura chiefly dark brown, variegated by pale yellowish white, the latter including only the dorsopleural region and the pteropleurite. Halteres pale, the knobs infuscated. Legs with the fore coxæ dark brown, the remaining coxæ and all trochanters obscure yellow; remainder of legs broken. Wings subhyaline, with a heavy brown costal pattern, arranged as in the group, leaving pale areas in the outer ends of cells R_2 and R_3; veins pale brown, darker in the infuscated costal region. Venation: Rs with a conspicuous loop at origin, the spur relatively short; forks of medial field deep.

Abdominal segments obscure yellow, their caudal margins narrowly infuscated, the hypopygium chiefly pale. Male hypopygium (Plate 2, fig. 26) with the median region of the tergite, 9*t*, produced into a low triangular lobe, the lateral portions blackened but smooth. Dististyles, *id*, and phallosome, *p*, shaped as illustrated. Region of basistyle not at all produced, the sternal region, 9*s*, with a low tubercle on either side, these set with a brush or crown of about six flattened spinous setæ.

MINDANAO, Davao district, Mount Apo, Seliban River, altitude 6,500 feet, September 11, 1930 (*C. F. Clagg*); holotype, male.

The small size and structure of the male hypopygium readily serve to separate the present fly from allied forms.

DOLICHOPEZA (NESOPEZA) SETISTERNATA sp. nov. Plate 1, fig. 6; Plate 2, fig. 27.

Belongs to the *gracilis* group; general coloration pale yellow; mesonotal præscutum with three reddish brown stripes; pleura yellow, with a broken dorsal longitudinal stripe; legs pale, the tips of femora and tibiæ narrowly darkened; male hypopygium with the region of the basistyle not produced, the armature of the basistyle-sternite consisting of numerous elongate setæ.

Male.—Length, about 8 to 8.5 millimeters; wing, 8 to 9.

Female.—Length, about 9 to 10 millimeters; wing, 9 to 9.3.

Frontal prolongation of head short, brownish black; palpi paler brown. Antennæ with the scapal segments pale brown; basal flagellar segments pale brown, the outer segments darker; flagellar segments elongate-cylindrical, the subterminal verticil unusually small, not or but slightly exceeding the pubescence. Head brownish gray, more yellowish in front.

Mesonotal præscutum obscure yellowish white, with three reddish brown stripes, the median one divided by a darker median vitta; scutal lobes pale brown, the cephalic-lateral portion marked with darker; posterior sclerites of mesonotum more testaceous brown. Pleura yellow, with an interrupted dorsomedian brown stripe, extending from the cervical sclerites across the anepisternum and dorsal pleurotergite, interrupted on the pteropleurite. Halteres obscure yellow, the knobs infuscated. Legs with the coxæ and trochanters pale yellow; femora yellow, the tips narrowly and weakly infuscated; tibiæ whitish, the tips very narrowly and indistinctly dark; tarsi snowy white, the outer segments more infumed. Wings (Plate 1, fig. 6) subhyaline, with the usual dark pattern of the group, this somewhat paler brown than in some allied species; no dark cloudings beyond

caudal level of vein M except across the postarcular region; veins pale yellow, darker in the clouded areas. Venation: Medial forks deep.

Abdomen dark brown, the tergites variegated with obscure yellow before their caudal margins; basal sternites more extensively yellow; subterminal segments more uniformly darkened; hypopygium pale yellowish brown. Females with the tergites more uniformly darkened, the sternites yellow, with narrow transverse darkenings. Male hypopygium (Plate 2, fig. 27) with the lateral lobes of the tergite, 9*t*, low, on their ventral face with a comb of blackened points. Region of sternite, 9*s*, and basistyle provided with long coarse setæ only. Inner dististyle, *id*, large, suboval in outline, the margin with delicate setæ which pass into a group of four or five short spines near apex of style.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male, Seliban River, altitude 7,000 feet, September 3, 1930; allotype, female, Sibulan River, 7,000 to 8,000 feet, September 21, 1930; paratypes, 1 male, 2 females, Seliban River, 6,500 feet, September 11, 1930; 1 male, 1 female, with the allotype; 1 male, 2 females, Mainit River, 7,000 feet, September 15, 1930; 1 male, 2 females, Bakraeyon, 8,000 feet, September 16, 1930.

DOLICHOPEZA (NESOPEZA) QUADRIFILA sp. nov. Plate 1, fig. 7; Plate 3, fig. 28.

Belongs to the *cuneata* group, *cinctitarsis* subgroup; male hypopygium with the tergite long and narrow, the apex with a deep U-shaped median notch, each lateral lobe at apex split into two slender branches.

Male.—Length, about 10 millimeters; wing, 11.5.

Female.—Length, about 10 millimeters; wing, 12.

Frontal prolongation of head yellowish brown; palpi darker. Antennæ dark brown, the scapal segments yellow; flagellar segments elongate-cylindrical. Head dark brown; anterior vertex wide.

Mesonotum pale brown, the præscutum with three scarcely evident more yellowish stripes; scutal lobes and posterior sclerites of mesonotum darker brown. Pleura testaceous brown above, paling almost to whitish on the ventral pleurites. Halteres elongate, black. Legs with the coxæ and trochanters pale, the fore coxæ slightly more infuscated; femora brownish black; tibiæ black, the genua restrictedly whitened; tarsi snowy white, the basitarsi extensively darkened medially, as in the *cuneata* group. Wings (Plate 1, fig. 7) with a dusky tinge, the oval stigma dark brown; somewhat brighter areas before and beyond the stigma; veins dark brown. Venation: Cell M_4 narrower at

base than at outer end, as in the group; cell 2d A very narrow, with a distinct vestige of a fold or third anal vein behind it.

Abdomen dark brown, ringed with obscure yellow on basal third; outer segments more uniformly darkened; hypopygium chiefly obscure yellow, especially the conspicuous tergites. Male hypopygium (Plate 3, fig. 28) with the tergite, 9*t*, very long and narrow, as in the subgroup, the apex with a deep U-shaped median notch; each lateral lobe split at tip into a shorter outer and a somewhat longer inner and more ventral branch, all branches slightly expanded and more or less truncated at their tips.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male, allotype, female, Bakraeyon trail, altitude 8,000 feet, September 16, 1930; paratype, male, Galog River, altitude 6,000 feet, September 8, 1930.

DOLICHOPEZA (NESOPEZA) BAGOBO sp. nov. Plate 3, fig. 29.

Belongs to the *cuneata* group and subgroup; antennæ (male) relatively short, if bent backward not or scarcely exceeding the wing root; male hypopygium with the tergite small, the lateral and sublateral teeth obtuse and separated by a shallow notch; sternite pale, the apex obtuse but entire.

Male.—Length, about 8.5 to 9 millimeters; wing, 10 to 11.

Female.—Length, 10.5 to 11 millimeters; wing, 11.

Frontal prolongation of head yellowish testaceous; palpi light brown, darkened outwardly. Antennæ with the first scapal segment obscure yellow, the remainder brown, passing into dark brown or black; antennæ of moderate length, if bent backward scarcely exceeding the wing root. Head brown, the front brightening to obscure fulvous; a paler occipital spot.

Mesonotal præscutum brown, with three brighter, more reddish brown, stripes; scutum dark brown, the median area paler, the lobes variegated with reddish brown areas; scutellum and postnotum brown. Pleura obscure yellow. Halteres elongate, black. Legs with the coxæ and trochanters testaceous yellow, the latter with a black spot on ventral face; femora and tibiæ brownish black, the genua very restrictedly whitened; tarsi white, the central portion of the basitarsus blackened. Wings with a faint brownish tinge, the small oval stigma dark brown; narrow dark seams along the cord; veins brownish black. Venation: Forks of medial field deep.

Abdominal tergites bicolorous, black, the central portions of the individual segments obscure yellow; subterminal segments

more uniformly darkened; hypopygium obscure yellow; sternites more uniformly yellow. Male hypopygium (Plate 3, fig. 29) with the tergite, 9*t*, relatively small, the margin toothed about as illustrated. Styli, *d*, as shown. Ninth sternite pale, appearing as a concave sheath, the apex obtuse, entire, and provided with abundant short setæ.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male, Mainit River, altitude 6,500 feet, September 10, 1930; allotype, female, in copula with type; paratypes, 1 male, 1 female, Galog River, 6,000 feet, September 1, 1930; 1 female, Tio Ridge, 6,500 feet, September 5, 1930.

Dolichopeza (*Nesopeza*) *bagobo* is named from one of the native tribes living near Mount Apo. The species is most nearly allied to *D.* (*N.*) *cuneata* Edwards (Borneo) and *D.* (*N.*) *angustaxillaris* Alexander (Luzon), the three species being most readily separated by the structure and toothing of the ninth tergite of the male hypopygium.

CYLINDROTOMINÆ

STIBADOCERA OPALIZANS sp. nov. Plate 1, fig. 8.

Size large (wing, male, 9 millimeters; antenna, 12); head blue-black, punctate behind; antennal flagellum entirely dark; mesonotum pale reddish brown, the præscutum with three impunctate reddish stripes, the whole surface with light blue to opalescent reflexions; coxæ and femoral bases yellow, remainder of legs black; wings with a strong blackish tinge; abdomen with the basal segment light yellow, the remaining tergites black.

Male.—Length, about 8 millimeters; wing, 9; antenna, about 12.

Female.—Length, about 6 millimeters; wing, 6.5; antenna, about 1.6.

Antennæ with the entire flagellum dark brown. Head deep metallic blue, with coarse punctures on the posterior vertex and occiput.

Mesonotal præscutum with the interspaces light brown, coarsely punctured, the usual three stripes reddish, smooth, the entire surface with opalescent to blue reflections; posterior sclerites of mesonotum reddish, with similar opalescent reflections. Pleura chestnut-red, with coarse punctures, the ventral sternopleurite and meron glabrous, the surface of the pleura with opalescent reflections; dorsopleural region light yellow. Halteres dark brown, the extreme base of stem light yellow. Legs with the coxæ and trochanters yellow; femora dark brown, the base more

yellow; remainder of legs black. Wings (Plate 1, fig. 8) with a strong blackish tinge, the costal margin darker; veins brownish black. Venation: Outer section of Rs subequal to or slightly shorter than r-m; free tip of Sc_2 variable in position, in cases almost as far distad as the fork of R_{2+3}.

Abdomen with the basal segment light yellow; remainder of abdomen dark brown or black, including the hypopygium, the basal sternites light yellow.

The female that I am referring here has the thorax much darker, blackish, with blue-black reflections, the posterior third of the præscutum more reddish.

MINDANAO, Davao district, Mount Apo, Lino Lake and Kidapawan trail from the lake, altitude 7,000 to 8,000 feet, September 19 to 21, 1930 (*C. F. Clagg*); holotype, male; allotype, female; paratypes, 4 males.

Stibadocera opalizans is generally similar to *S. metallica* Alexander (Java) and *S. fasciata* Edwards (Borneo), differing chiefly in details of coloration. I am considering all three as representing closely allied vicarious species rather than as being subspecies, as was done by Edwards. The three form a group of closely allied forms that are very different from the only other known Philippine species of the genus, *S. pumila* Alexander (Luzon).

LIMONIINÆ

LIMONIINI

HELIUS (EURHAMPHIDIA) ATÁ sp. nov. Plate 1, fig. 9

Mesonotal præscutum ocherous, narrowly darkened medially; femora light brown, the tips paling to dirty white; tibial bases not brightened, the tips broadly snowy white.

Female.—Length, about 5.5 millimeters; wing, 5.3.

Rostrum a little longer than the head, brown, the palpi dark brown. Antennæ with the scapal segments black, the basal two or three flagellar segments obscure yellow, the remaining segments black. Head light gray.

Pronotum buffy brown, darker medially. Mesonotal præscutum ocherous, with a narrow dark brown median stripe, the scutal lobes similarly darkened. Pleura ocherous yellow. Halteres pale, the knobs weakly infuscated. Legs with the coxæ and trochanters yellow; femora light brown, the tips paling very gradually and insensibly to dirty white; tibiæ brown, the bases not or scarcely brightened, the tips broadly snowy white, the amount greater on the fore tibiæ where about one-third

is included, narrowest on the posterior tibiæ where nearly one-fourth is brightened; tarsi snowy white, the terminal segments dark brown. Wings (Plate 1, fig. 9) with a whitish tinge, the stigma and apex a little darker; veins pale brown. Venation: Sc_2 ending a short distance beyond r-m; cell 1st M_2 subrectangular, with m-cu at or beyond midlength.

Abdomen dark brown, the sternites more yellowish.

MINDANAO, Davao district, Mount Apo, Mainit River, altitude 7,000 to 8,000 feet, September 15 to 21, 1930 (*C. F. Clagg*); holotype, female; paratype, female.

The specific name, *atá*, is that of a local tribe. The Philippine species of the genus *Helius* may be separated by means of the following key:

Key to the Philippine species of Helius St. Fargeau.

1. Wings with the r-m crossvein connecting with Rs before the fork..... 2.
   Wings with the r-m crossvein connecting with R_{4+5}, beyond the fork of Rs. (*Helius* St. Fargeau, s. s.)..... 8.
2. Rostrum elongate, about equal in length to the thorax; wings with a reticulate brown pattern. (*Rhampholimnobia* Alexander.) (Luzon; Mindanao; Borneo; Java.)..... *H.* (*R.*) *reticulatus* Alexander.
   Rostrum short, a little longer than the head; wings unmarked, except for the stigmal area, when this is present. (*Eurhamphidia* Alexander.)..... 3.
3. Femoral tips dirty white to abruptly snowy white..... 4.
   Femoral tips not at all brightened..... 7.
4. Tips of femora dirty white, not abruptly brighter than the remainder; bases of tibiæ not conspicuously brightened. (Mindanao.)
   H. (*E.*) *atá* sp. nov.
   Tips of femora abruptly snowy white; bases of tibiæ similarly brightened..... 5.
5. Male hypopygium with the lateral arms of the tergite bearing a conspicuous slender lateral branch near base. (Luzon.)
   H. (*E.*) *diacanthus* Alexander.
   Male hypopygium with the lateral arms of the tergite simple, without branches..... 6.
6. Male hypopygium with the outer dististyle provided with abundant delicate setulæ. (Mindanao.)..... *H.* (*E.*) *indivisus* Alexander.
   Male hypopygium with the outer dististyle entirely glabrous. (Mindanao.)..... *H.* (*E.*) *glabristylatus* sp. nov.
7. Size large (wing, female, over 6 millimeters); rostrum relatively elongate, about one-half longer than the remainder of head; tips of tibiæ narrowly white, including less than the outer fourth of the mid-tibiæ. (Luzon.)..... *H.* (*E.*) *fuscofemoratus* Alexander.
   Size smaller (wing, female, under 5 millimeters); rostrum short, only a little longer than remainder of head; tips of tibiæ broadly white, including more than the outer third of mid-tibiæ. (Luzon; Mindanao.)..... *H.* (*E.*) *nigrofemoratus* Alexander.

8. Anterior branch of Rs fused apically with R_{1+2}, closing cell R_1..... 9.
Anterior branch of Rs reaching the wing margin as a distinct unit.... 10.
9. General coloration dark brown. (Luzon; Mindanao.)
H. (*H.*) *trianguliferus* Alexander.
General coloration pale ocherous. (Mindanao.)
H. (*H.*) *apoensis* sp. nov.
10. Anterior branch of Rs very strongly arcuated at origin, beyond base running generally parallel and close to R_{1+2}; m-cu slightly beyond the fork of M; cell 1st M_2 long-rectangular..... 11.
Anterior branch of Rs gently arcuated at origin, diverging gradually from the posterior branch; m-cu at fork of M; cell 1st M_2 nearly square to subpentagonal. (Luzon.)
H. (*H.*) *argyrosterna* Alexander.
11. Antennæ (male) elongate, if bent backward extending to beyond the root of the halteres. (Mindanao.)..... *H.* (*H.*) *procerus* Alexander.
Antennæ (male) short, if bent backward not reaching the wing base. (Luzon.) ..... *H.* (*H.*) *arcuarius* Alexander.

HELIUS (EURHAMPHIDIA) GLABRISTYLATUS sp. nov. Plate 1, fig. 10.

Closely related to *H.* (*E.*) *indivisus* Alexander, differing especially in the details of coloration and in the glabrous outer dististyle of the male hypopygium.

Male.—Length, about 3.7 millimeters; wing, 4.5.

Female.—Length, about 4.5 millimeters; wing, 4.5.

Head dark gray. Mesonotal præscutum chiefly dark brown, the lateral margins and humeral region extensively obscure yellow; scutal lobes brownish black; scutellum testaceous. Legs dark brown, the femoral tips broadly and abruptly, the tibial bases narrowly snowy white; tips of all tibiæ relatively narrowly snowy white, the amount subequal on all legs and only about one-half as wide as in *H. indivisus*. Venation as shown (Plate 1, fig. 10). Male hypopygium with the lateral arms of the tergite simple, as in *indivisus*. Outer dististyle entirely glabrous, without the thick covering of setulæ of *indivisus*.

MINDANAO, Davao district, Mount Apo, Kidapawan trail from Lake Lino, altitude 7,000 to 8,000 feet (*C. F. Clagg*); holotype, male; allotype, female; paratypes, 2 males, September 20, 1930; paratypes, 3 females, September 21 to 30, 1930.

HEXATOMINI

ULA MINDANICA sp. nov. Plate 1, fig. 11; Plate 3, fig. 30.

General coloration black, more or less pruinose; antennæ relatively short; halteres and legs chiefly blackened; wings with a strong dusky tinge, the costal border more blackish; cell 1st M_2 of wings very small.

Male.—Length, about 6 to 7 millimeters; wing, 8 to 8.5.

Female.—Length, about 6.5 to 7.5 millimeters; wing, 8 to 9. Rostrum brownish gray; palpi black. Antennæ black throughout; in male, of moderate length only, if bent backward extending to shortly beyond the wing root; flagellar segments long-oval, with unilaterally arranged verticils that are about as long as the segments. Head dark brown, pruinose.

Mesonotum black, sparsely pruinose; median region of scutum and the scutellum more pollinose with yellow. Pleura black, pruinose with gray, especially on the ventral pleurites. Halteres black, the base of stem restrictedly yellow. Legs with the coxæ obscure yellow, the bases weakly pruinose; trochanters brownish yellow; femora black, the bases yellow; remainder of legs black. Wings (Plate 1, fig. 11) with a strong dusky tinge, the costal region and stigma even more blackish; veins and macrotrichia black. Macrotrichiæ of cells relatively abundant beyond the cord, in the more basal cells restricted to the centers of the cells, their distribution about as illustrated; macrotrichia of veins unusually long and slender. Venation: Cell 1st M_2 very small, vein M_{1+} beyond it usually more than four times the length of the cell.

Abdomen black, sparsely pruinose, the basal segments a little paler; hypopygium chiefly darkened. Male hypopygium (Plate 3, fig. 30) with the dististyle, *d*, single, bearing about a dozen black spines. Interbasal process, *i*, a slender rod, slightly expanded at outer end. Gonapophyses, *g*, nearly as long as the interbases but more slender, acute at tips. Ædeagus, *a*, large, compressed on basal and central portions.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male; allotype, female; Sibulan River, altitude 7,000 to 8,000 feet, September 21, 1930; paratypes, 1 male, Mainit River, 6,000 feet, September 24, 1930, 1 female, 7,000 feet, September 15, 1930; 3 males, 1 female, Kidapawan trail from Lake Lino, 7,000 to 8,000 feet, September 20, 1930; 1 male, Seliban River, 7,000 feet, September 11, 1930.

Ula mindanica is most closely allied to *U. javanica* Alexander (Java), differing in the details of coloration of the body, halteres, and legs, together with slight details of venation and trichiation, especially the long macrotrichia of the wing veins.

PSEUDOLIMNOPHILA LEGITIMA sp. nov. Plate 1, fig. 12; Plate 3, fig. 31.

General coloration yellow, the mesonotum dark brown; antennæ short in both sexes; legs chiefly brownish black, the tarsi in

cases a trifle paler; wings with the costal fringe short; cell M_1 present.

Male.—Length, about 5.5 to 6.5 millimeters; wing, 7 to 7.5.

Female.—Length, about 7 to 7.5 millimeters; wing, 7 to 8.

Rostrum obscure yellow to brown; palpi black. Antennæ relatively short in both sexes, black throughout; flagellar segments cylindrical, with very long, conspicuous verticils on the outer flagellar segments. Head dark gray; anterior vertex nearly twice as wide as the diameter of the scape.

Pronotum and mesonotum dark brown, the humeral and lateral regions of the præscutum yellow; median area of scutum and base of scutellum obscure yellow; central portion of mediotergite blackened, the lateral areas and the pleurotergite yellow. Pleura yellow, the dorsopleural region and areas surrounding the wing root usually dark brown; dorsal sternopleurite and anepisternum, in cases weakly suffused with brown. Halteres brown, the stem brighter. Legs with the coxæ and trochanters yellow; femora brownish black, the bases obscure yellow; tibiæ brownish black; tarsi brown to brownish black. Wings (Plate 1, fig. 12) with a brownish tinge, iridescent; stigma and a marginal seam in the radial field to vein R_4 dark brown; veins brownish black. Costal fringe relatively short. Venation: Sc_1 ending just beyond r-m, Sc_2 nearly opposite the fork of Rs; R_2 a little shorter than R_{2+3}; R_3 relatively short, sinuous, diverging from vein R_4, cell R_3 at margin subequal to cell R_2; cell M_1 present, shorter than its petiole; m-cu at or close to fork of M.

Abdominal tergites dark brown, brightened laterally; sternites paler, obscure yellow; a narrow dark brown subterminal ring; hypopygium with the basistyli obscure yellow. Male hypopygium (Plate 3, fig. 31) with the dististyles long and slender, the outer, *od,* nearly straight, the slender tip curved to an acute point.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male; allotype, female, Mainit River, altitude 6,500 feet, September 14, 1930; paratopotypes, 44 males and females, 6,000 to 6,500 feet, September 9 to 23, 1930; paratypes, 1 male, Seliban River, 7,000 feet, September 11, 1930; 1 female, Poraka River, 6,500 feet, September 8, 1930; 1 female, Sibulan River, 6,000 feet, August 31, 1930; 7 males and females, Galog River, 6,000 feet, September 3 to 8, 1930; 1 female, Galog River trail, 5,000 to 6,000 feet, September 12, 1930.

The present species is readily told by the diagnostic characters listed. The known Philippine species of *Pseudolimnophila* may be separated by the following key:

Key to the Philippine species of Pseudolimnophila.

1. Cell M_1 of wings present ..... 2.
   Cell M_1 of wings lacking ..... 3.
2. Legs black, the tarsi abruptly light yellow; wings narrow, the margins of outer radial cells not suddenly darkened. (Luzon.) *P. luteitarsis* Alexander.
   Legs black, the tarsi only slightly if at all paler than the tibiæ; wings broad, the outer margins of cells R_2 and R_3 suddenly darkened. (Mindanao.) ..... *P. legitima* sp. nov.
3. Wings broad, the outer radial cells narrowly dark brown; tarsi black. (Mindanao.) ..... *P. illegitima* sp. nov.
   Wings narrow, the outer radial cells not darkened; tarsi paling to golden yellow. (Mindanao.) ..... *P. auripes* sp. nov.

PSEUDOLIMNOPHILA ILLEGITIMA sp. nov. Plate 1, fig. 13.

Male.—Length, about 6.5 to 7 millimeters; wing, 7 to 7.2.

Female.—Length, about 8 millimeters; wing, 7.5.

Very similar in all respects to *P. legitima* sp. nov., differing only in the total loss of cell M_1 of the wings. Legs black, the tarsi scarcely if any brightened. Wings (Plate 1, fig. 13) with a strong brownish yellow tinge, cells C and Sc clearer yellow; stigma and a conspicuous marginal seam in cells R_2 and R_3 dark brown; veins brownish black. Venation: Anterior branch of Rs extending generally parallel to R_4, cell R_3 at margin much narrower than cell R_2; cell M_1 lacking; m-cu close to inner end of cell 1st M_2.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male, Mainit River, altitude 6,000 feet, September 9, 1930; allotype, female, Galog River, 6,000 feet, September 7, 1930; paratopotypes, 2 males, 6,000 to 6,500 feet, September 14 to 24, 1930; paratype, 1 male, with the allotype, September 8, 1930.

PSEUDOLIMNOPHILA AURIPES sp. nov. Plate 1, fig. 14.

Male.—Length, about 6 to 7.5 millimeters; wing, 7 to 8.3.

Female.—Length, about 8.5 to 9 millimeters; wing, 8 to 9.

Generally similar to *P. illegitima* sp. nov., in the loss of cell M_1, differing most conspicuously in the yellow tarsi and the much narrower wings. Antennæ short in both sexes, black throughout, with long conspicuous verticils. Head black, with a sparse pruinosity.

Mesonotum chiefly dark brown, the humeral and lateral portions of the præscutum more yellowish; in cases, the entire

præscutum more uniformly reddish yellow. Pleura obscure yellow, the dorsopleural region more infuscated. Halteres brown. Legs with the coxæ and trochanters obscure yellow, the fore coxæ more infuscated; femora brownish black; tibiæ brown to pale brown; tarsi more golden yellow. Wings (Plate 1, fig. 14) long and narrow, tinged with brown, cells C and Sc a little darker; stigma pale brown; veins dark brown; no darkening in outer ends of cells R_2 and R_3. Venation: R_{2+3+4} long and strongly arcuated; anterior branch of Rs running nearly parallel to vein R_3; cell M_1 lacking; m-cu near inner end of cell 1st M_2; cell 2d A narrow. Abdominal tergites brownish black, the sternites obscure yellow.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male, Galog River, altitude 6,000 feet, September 8, 1930; allotopotype, female; paratopotypes, several of both sexes, September 7 to 26, 1930; paratypes, several of both sexes, Mainit River, 6,000 to 6,500 feet, September 9 to 24, 1930. One specimen is labelled as having been taken on grass at hot springs.

LIMNOPHILA (LIMNOPHILA) BITUMINOSA sp. nov. Plate 1, fig. 15; Plate 8, fig. 32.

General coloration coal-black, with a very sparse reddish brown pollen, the black coloration including the entire thoracic pleura and abdomen; legs chiefly dark brown, the tips blackened; wings cream-colored, with a very heavy fasciate dark brown pattern.

Male.—Length, about 6.5 to 7 millimeters; wing, 6.8 to 7.5.

Female.—Length, about 7.5 millimeters; wing, 7.8.

Rostrum and palpi black. Antennal scape black, the flagellar segments more brownish black; antennæ short in both sexes; basal flagellar segments short-oval, becoming more elongate outwardly and here provided with long conspicuous verticils. Head black, with a reddish brown pollen.

Thorax chiefly black, with a sparse reddish brown pollen. Halteres pale yellow. Legs with the coxæ brownish black, the fore coxæ paler apically; trochanters obscure yellow; remainder of legs chiefly brownish black, the femoral bases obscure yellow; in cases the femora are dark brown, with the tips blackened, and with a more or less distinct paler subterminal ring; legs with conspicuous suberect setæ. Wings (Plate 1, fig. 15) cream-colored, with a very heavy dark brown crossbanded pattern, the broadest fasciæ at level of origin of Rs and along the cord; other areas include the wing tip, across the middle of the outer radial field and as a postarcular darkening; individual clouds in basal half of cell 2d A and as a confluent series of clouds in cell M;

veins pale yellow, darker in the clouded areas. The degree of the dark pattern varies in different individuals, in some being lighter, with the dark seam at outer end of cell 1st M_2 widely separated from the band at the cord; in the other extreme of specimens, the dark areas are so extensive as virtually to cover the entire ring. Costal fringe long and conspicuous. Venation: Sc relatively short, Sc_1 ending about opposite the fork of Rs, Sc_2 close to its tip; R_2 faint, considerably shorter than R_{1+2} cell M_1 present; m-cu at or beyond midlength of cell 1st M_2; anterior arculus preserved.

Abdomen, including the hypopygium, black. Male hypopygium (Plate 3, fig. 32) with the outer dististyle, *od*, a simple curved rod, narrowed to an acute point, the outer surface with abundant erect setæ. Gonapophyses, *g*, appearing as flattened blades. Interbasal processes, *i*, blackened, capitate.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male, Kidapawan trail from Lake Lino, altitude 7,000 to 8,000 feet, September 20, 1930; allotype, female, Lino Lake, 8,000 feet, September 19, 1930; paratopotypes, 25 of both sexes; paratypes, 10 males, with the allotype.

Limnophila bituminosa is most closely allied to *L.* (*L.*) *benguetana* Alexander (Luzon), *L.* (*L.*) *guttularis* Edwards (Borneo) and *L.* (*L.*) *murudensis* Edwards (Borneo), differing from all in the uniformly blackened body and unusually heavy wing pattern. It is evident that females are very rare in this particular group of the subgenus, the present large series including only two of this sex.

PILARIA LEUCOPODA sp. nov. Plate 1, fig. 16; Plate 3, fig. 33.

General coloration of mesonotum brown, the præscutum more obscure reddish; pleura ocherous gray, striped longitudinally with black; tarsi chiefly white; wings with a strong dusky tinge; anterior branch of Rs short, cell R_3 at margin correspondingly widened; cell M_1 lacking; male hypopygium with the lobes of the tergite setiferous; longest gonapophysis toothed along margin.

Male.—Length, about 6 to 7 millimeters; wing, 8 to 8.5.

Rostrum and palpi black. Antennæ short; scapal segments black; basal segments of flagellum obscure yellow, the outer segments passing into dark brown; basal segments of flagellum short and crowded, with short verticils; outer segments more elongated, with long conspicuous verticils. Head dark brownish gray, the orbits narrowly light gray; anterior vertex broad.

Pronotum large, dark in color, with a grayish white pruinosity. Mesonotal præscutum obscure reddish, with vague indica-

tions of four darker stripes on posterior half, the intermediate pair of these stripes continued as a central darkening more or less to the cephalic margin of the sclerite; pseudosutural foveæ large; posterior sclerites of mesonotum dark brown. Pleura light ocherous gray, conspicuously variegated with velvety black, this color appearing chiefly as two interrupted longitudinal stripes, the more dorsal including the propleura and ventral anepisternum, the ventral stripe including the ventral sternopleurite and the hypopleural and meral regions. Halteres pale, the knobs weakly darkened. Legs with the coxæ obscure yellow, the fore coxæ more darkened; trochanters obscure yellow; femora obscure yellow basally, passing into brown; tibiæ brown; tarsi chiefly white, most extensive on the posterior tarsi, where all the basitarsus is included, least extensive on the fore tarsi where the outer fifth or sixth of the basitarsus is brightened. Wings (Plate 1, fig. 16) with a strong dusky tinge, the oval stigma darker brown; longitudinal subhyaline streaks in the basal radial, medial, cubital, and anal cells; veins dark brown. Venation: Sc_1 ending opposite or just beyond the fork of Rs, Sc_2 some distance from its tip; R_2 close to fork of R_{3+4}, sometimes before this fork, in other cases with R_2 subequal to R_{2+3}; anterior branch of Rs unusually short, as in *phœnosoma,* the cell at margin very wide; cell M_1 lacking; m-cu at near one-third the length of cell 1st M_2.

Abdominal tergites black, variegated with obscure orange-yellow on the posterior portions of the segments; outer segments more uniformly blackened; sternites obscure yellow, the bases of the individual segments narrowly darkened. Male hypopygium (Plate 3, fig. 33) with the caudal margin of the tergite, 9*t*, produced into two conspicuous submedian setiferous lobes that are separated by a narrow U-shaped notch. Outer dististyle, *od,* slender, glabrous, terminating in a small oval recurved flap or operculum. Inner dististyle a broad mitten-shaped lobe, narrower than in *phœnosoma.* Longest gonapophysis, *g,* terminating in an acute point, the margin with a few conspicuous denticles.

MINDANAO, Davao district, Mount Apo (*C. F. Clagg*); holotype, male, Mainit River, altitude 6,000 feet, September 4, 1930; paratopotypes, 3 males, 6,000 to 6,500 feet, September 14 to 22, 1930.

Pilaria leucopoda is readily told from *P. phœnosoma* Alexander (Luzon), its closest ally, by the white tarsi, as well as the very different structure of the male hypopygium.

ERIOCERA NIGRONOTATA sp. nov. Plate 1, fig. 17.

Belongs to the *pyrrhochroma* group; general coloration obscure fulvous; sides of mesonotum and the pleura with small velvety-black spots; wings with a yellowish brown tinge; cell M_1 present.

Male.—Length, about 9 to 11 millimeters; wing, 10.5 to 13.

Rostrum and palpi black. Antennæ short; scapal segments obscure yellow; flagellum black. Head dark gray, the center of the vertex darkened.

Mesonotal præscutum obscure fulvous, with two velvety-black lateral spots, one behind the pseudosutural foveæ, the other at the suture; posterior sclerites of mesonotum brown, slightly plumbeous. Pleura yellow, with a velvety-black spot between the anepisternum and sternopleurite, with a smaller spot below and in front of the wing root. Halteres infuscated, the base of the stem narrowly brightened. Legs with the coxæ and trochanters yellow; femora dark brown, the bases obscure yellow; tibiæ and tarsi dark brown. Wings (Plate 1, fig. 17) with a yellowish brown tinge, the costal region and wing tip slightly more darkened; the actual stigma dark brown but very small, appearing as a seam at outer end of vein R_1; veins brown, paler in the basal and subcostal regions, blacker beyond the cord. Venation: Rs long, in alignment with R_5, the basal section of the latter being obliterated; r-m at fork of Rs; cell R_3 angulated at base; R_2 longer than the upturned R_{1+2}; cell M_1 present, about equal to its petiole; m-cu about its own length beyond the fork of M; distal section of Cu_1 a little longer than m-cu, nearly in alignment with the basal section.

Basal abdominal segments obscure yellow medially, darkened laterally, the outer segments more uniformly velvety black; hypopygium chiefly blackened.

MINDANAO, Davao district, Mount Apo, altitude 6,000 feet, September 4 to 26, 1930 (*C. F. Clagg*); holotype, male; paratype, male.

By Edwards's key to the Old World species of *Eriocera*,[6] the present fly runs to couplet 29, disagreeing in the combination of having cell M_1 present and with black spots on sides of mesonotum; running farther on the basis of presence of cell M_1, the fly runs to couplet 33, disagreeing with both included species. By Edwards's key to the Philippine species of *Eriocera*,[7] the

[6] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.
[7] Notulae Entomologicae 6 (1926) 38–39.

present fly runs to couplet 12, disagreeing in the venation, which is that of *pyrrhochroma* and allied species in the Oriental fauna. Such species have the basal section of R_5 obliterated or nearly so and with r-m at or close to the fork of Rs.

ERIOPTERINI

GNOPHOMYIA OBESULA sp. nov. Plate 1, fig. 18; Plate 3, fig. 34.

General coloration black; antennæ (male) elongate, exceeding one-half the length of the body; halteres and legs black; wings with a strong blackish tinge; male hypopygium with the outer dististyle simple, unusually stout; inner dististyle a small simple black spine; ædeagus short.

Male.—Length, about 3.5 millimeters; wing, 4; antenna, about 2.

Rostrum and palpi black. Antennæ black throughout, elongate in male; flagellar segments long-cylindrical, the longest verticils subequal to the segments, the remainder of organ with numerous long, coarse, scattered setæ. Head black.

Thorax black, very sparsely pruinose. Halteres black, the extreme base of stem pale. Legs with the coxæ and trochanters black; remainder of legs brownish black. Wings (Plate 1, fig. 18) with a strong blackish tinge, the stigma scarcely indicated; certain of the veins, especially Cu and the end of Rs, more clouded with brown; veins black. Venation: Sc_1 ending shortly before the level of R_2; Rs in alignment with R_5; r-m at or shortly before the fork of Rs; m-cu at near one-third the length of cell 1st M_2.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 34) with the outer dististyle, *od,* unusually stout and tumid, gradually narrowed to a subacute tip, with a few scattered setigerous punctures. Inner style a small acute spine. Ædeagus relatively short.

MINDANAO, Davao district, Mount Apo, Galog River, altitude 6,000 feet, August 31, 1930 (*C. F. Clagg*); holotype, male.

Gnophomyia obesula is most closely allied to *G. macrocera* Alexander (Luzon), differing in the shorter antennæ and, especially, the very different structure of the male hypopygium.

TOXORHINA (TOXORHINA) TUBERCULATA sp. nov. Plate 3, fig. 35.

General coloration of notum gray; rostrum elongate; thoracic pleura dark brown above, paler below; wings with a faint brownish tinge; male hypopygium with the setæ of the mesal face of the basistyle simple; outer dististyle a simple elongate

spine; inner dististyle a flattened blade that bears a small erect tubercle on outer margin of basal half.

Male.—Length, excluding rostrum, about 5 millimeters; wing, 4.6; rostrum, about 4.5.

Rostrum elongate, only a little shorter than the body, black. Antennæ black, the basal segments pruinose. Head light gray.

Pronotum brownish black. Mesonotal præscutum brownish gray medially, the humeral region vaguely brightened; posterior sclerites of mesonotum clearer gray. Pleura with the dorsopleural membrane and dorsal pleurites, including the roots of the wings and halteres, brownish black; ventral pleurites obscure yellow, the ventral sternopleurite again darkened. Halteres brownish black, the extreme base of stem obscure yellow. Legs with the coxæ and trochanters light yellow; femora brown, the bases paler; remainder of legs brownish black. Wings with a faint brownish tinge; veins black. Venation: Cell M_2 open by the atrophy of m.

Abdominal tergites brownish black, the sternites paler. Male hypopygium (Plate 3, fig. 35) with the setæ of the mesal face of the basistyle, *b*, simple. Outer dististyle, *od*, a simple elongate spine from a dilated base. Inner dististyle, *id*, a flattened blade, on basal half of outer margin with a small erect tubercle. Arms of ædeagus, *a*, relatively short.

MINDANAO, Davao district, Mount Apo, Mainit River, altitude 6,500 feet, September 14, 1930 (*C. F. Clagg*); holotype, male.

Toxorhina (*Toxorhina*) *tuberculata* is most readily told from its closest allies, *T.* (*T.*) *duyagi* Alexander (Luzon) and *T.* (*T.*) *montina* Alexander (Luzon), by the structure of the dististyles of the male hypopygium.

ILLUSTRATIONS

[Legend: *a*, ædeagus; *b*, basistyle; *d*, dististyles; *g*, gonapophysis; *i*, interbasal process; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite.]

Plate 1

Fig. 1. *Scamboneura claggi* sp. nov., wing.
2. *Scamboneura citridorsum* sp. nov., wing.
3. *Dolichopeza* (*Dolichopeza*) *atá* sp. nov., wing.
4. *Dolichopeza* (*Nesopeza*) *multiguttula* sp. nov., wing.
5. *Dolichopeza* (*Nesopeza*) *productula* sp. nov., wing.
6. *Dolichopeza* (*Nesopeza*) *setisternata* sp. nov., wing.
7. *Dolichopeza* (*Nesopeza*) *quadrifila* sp. nov., wing.
8. *Stibadocera opalizans* sp. nov., wing.
9. *Helius* (*Eurhamphidia*) *atá* sp. nov., wing.
10. *Helius* (*Eurhamphidia*) *glabristylatus* sp. nov., wing.
11. *Ula mindanica* sp. nov., wing.
12. *Pseudolimnophila legitima* sp. nov., wing.
13. *Pseudolimnophila illegitima* sp. nov., wing.
14. *Pseudolimnophila auripes* sp. nov., wing.
15. *Limnophila* (*Limnophila*) *bituminosa* sp. nov., wing.
16. *Pilaria leucopoda* sp. nov., wing.
17. *Eriocera nigronotata* sp. nov., wing.
18. *Gnophomyia obesula* sp. nov., wing.

Plate 2

Fig. 19. *Scamboneura claggi* sp. nov., male hypopygium, details.
20. *Scamboneura citridorsum* sp. nov., male hypopygium, details.
21. *Scamboneura subdotata* sp. nov., male hypopygium, details.
22. *Scamboneura opacinotum* sp. nov., male hypopygium, details.
23. *Dolichopeza* (*Dolichopeza*) *atá* sp. nov., male hypopygium, details.
24. *Dolichopeza* (*Nesopeza*) *nigrofemorata* sp. nov., male hypopygium, details.
25. *Dolichopeza* (*Nesopeza*) *productula* sp. nov., male hypopygium, details.
26. *Dolichopeza* (*Nesopeza*) *parvella* sp. nov., male hypopygium, details.
27. *Dolichopeza* (*Nesopeza*) *setisternata* sp. nov., male hypopygium, details.

Plate 3

Fig. 28. *Dolichopeza* (*Nesopeza*) *quadrifila* sp. nov., male hypopygium, details.
29. *Dolichopeza* (*Nesopeza*) *bagobo* sp. nov., male hypopygium, details.
30. *Ula mindanica* sp. nov., male hypopygium.
31. *Pseudolimnophila legitima* sp. nov., male hypopygium.
32. *Limnophila* (*Limnophila*) *bituminosa* sp. nov., male hypopygium.
33. *Pilaria leucopoda* sp. nov., male hypopygium.
34. *Gnophomyia obesula* sp. nov., male hypopygium.
35. *Toxorhina* (*Toxorhina*) *tuberculata* sp. nov., male hypopygium.

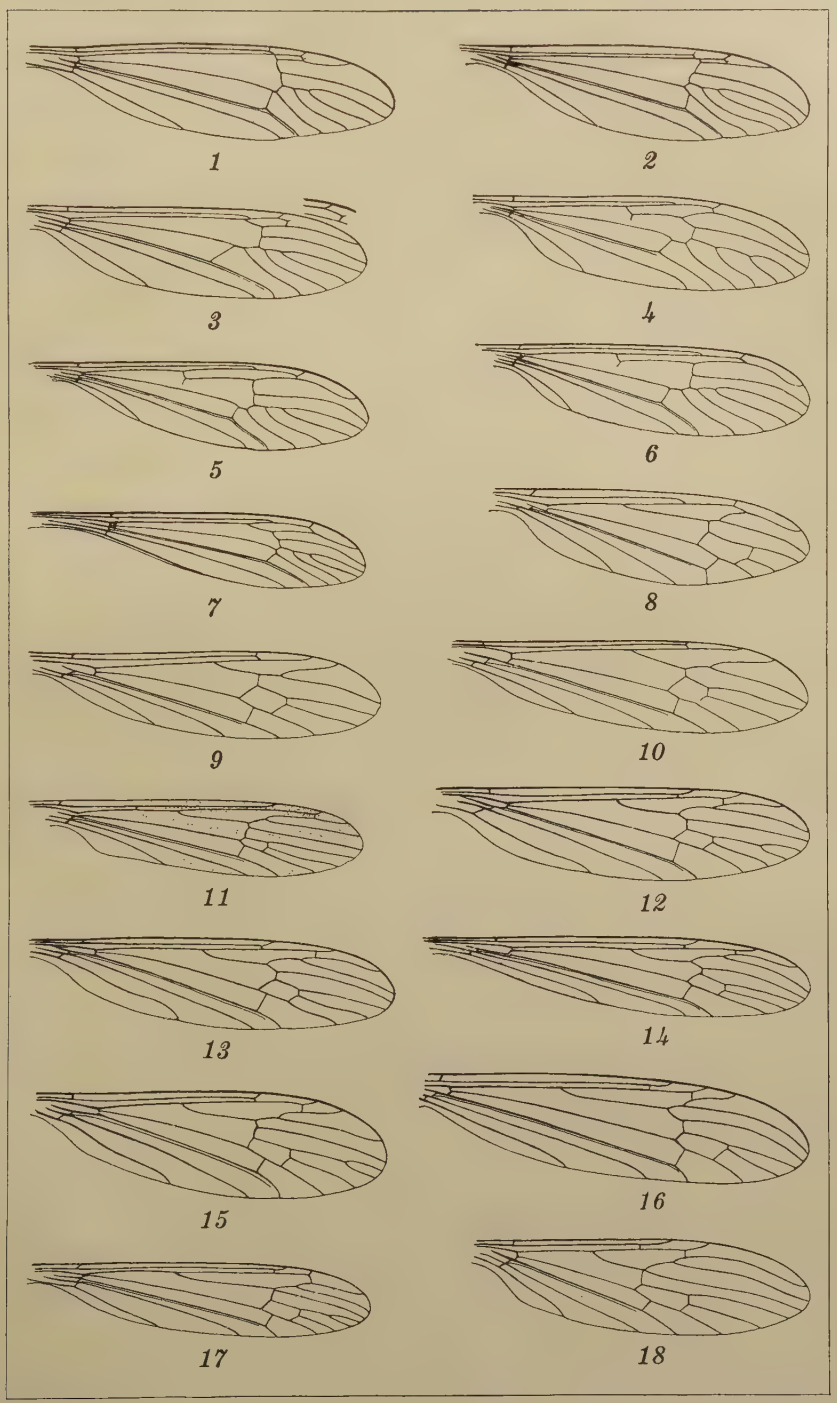


PLATE 1.

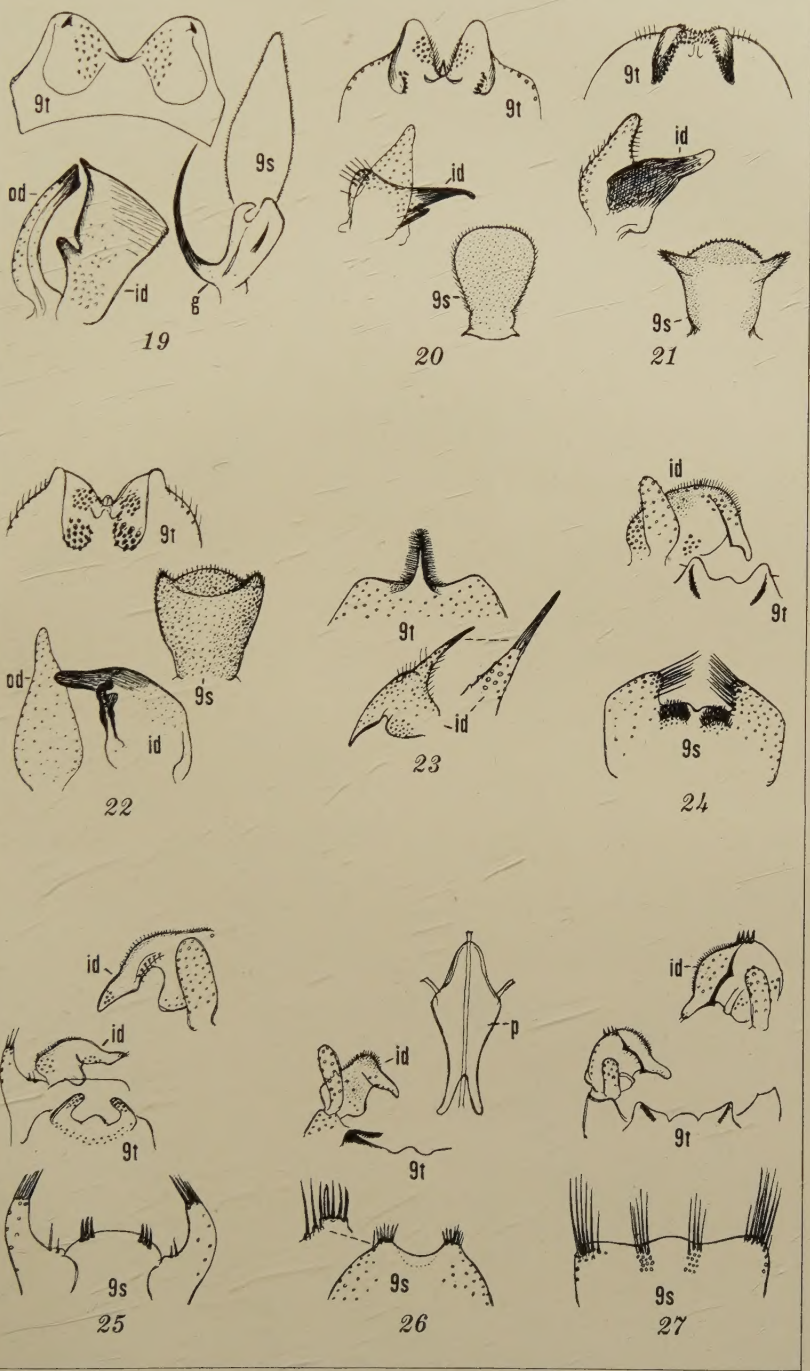

9t
9s
od
id
g
19
9t
id
9s
20
9t
id
9s
21
9t
od
9s
id
22
9t
id
23
id
9t
9s
24
id
id
9t
25
id
p
9t
26
id
9t
9s
27

PLATE 2.

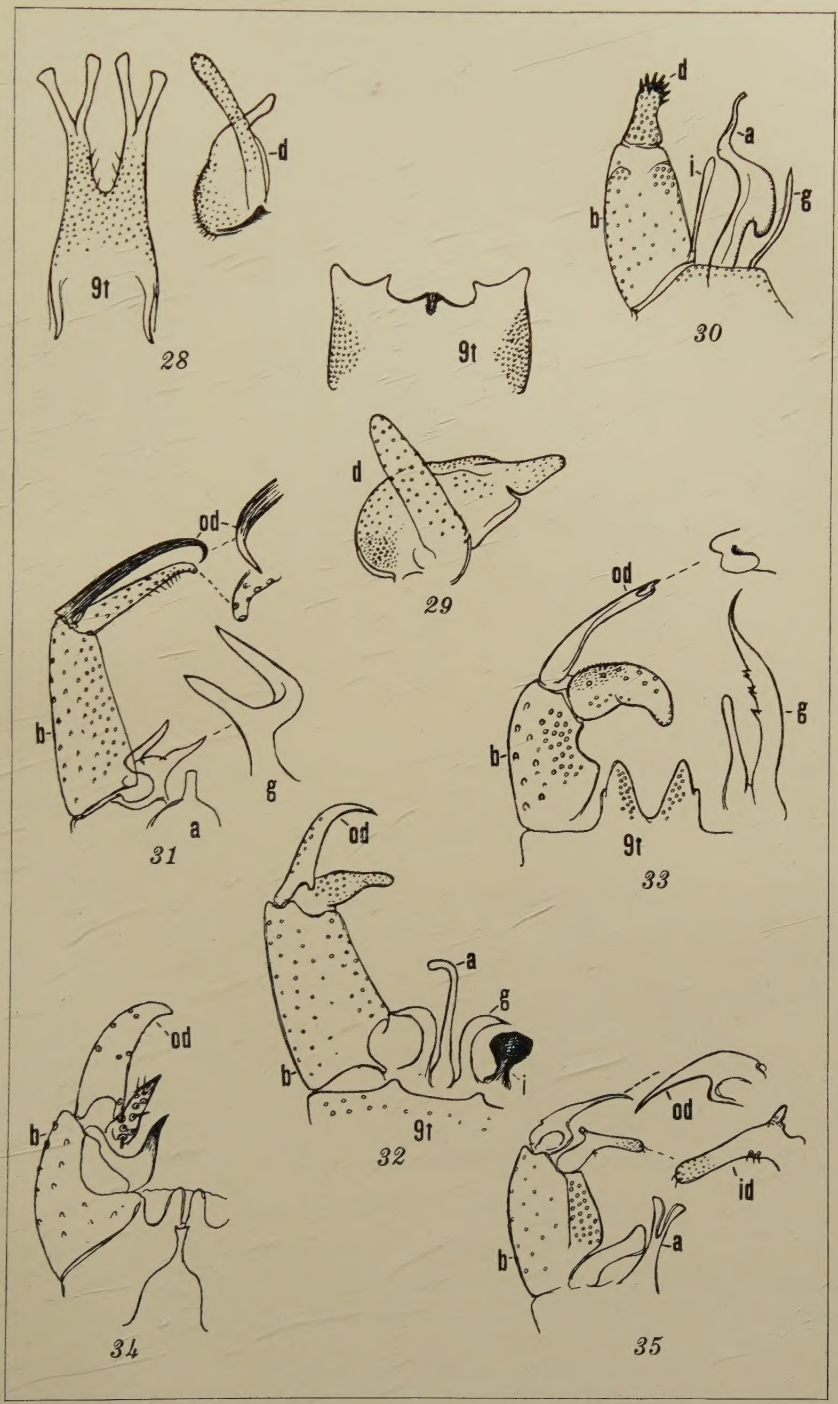

d
9t
28
9t
d
29
d
a
i
b
g
30
od
b
g
a
31
od
g
b
9t
33
od
a
g
b
i
9t
32
od
b
34
od
id
a
b
35

PLATE 3.